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GRANITE RESERVOIR DAM. (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV APR 79

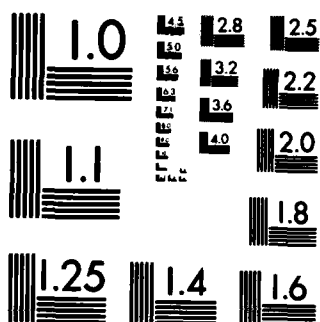
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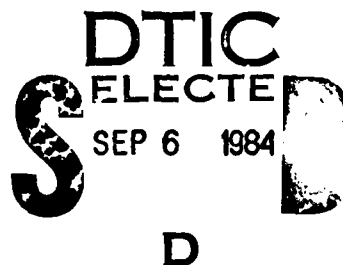
FRENCH RIVER BASIN
OXFORD, MASSACHUSETTS



GRANITE RESERVOIR DAM
MA 00105

PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

APRIL 1979

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| 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, French River Basin Oxford, Massachusetts | | |
| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Granite Reservoir Dam is a 615 foot long, 18 foot high earthfill dam. The dam is in poor condition. The dam has been placed in the "significant" hazard category. An outflow test flood ($\frac{1}{2}$ the PMF) of 2,800 cfs at El 635.7 will over-top the dam by 1.3 feet. The spillway can discharge 38% of the test flood. | | |



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDED

JUN 18 1979

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

I am forwarding to you a copy of the Granite Reservoir Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition, a copy of the report has also been furnished the owner, Town of Charlton, Charlton, Massachusetts 01507.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for your cooperation in carrying out this program.

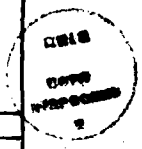
Sincerely yours,

Incl
As stated

JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

Pierce

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GRANITE RESERVOIR DAM
(SOUTH CHARLTON RESERVOIR DAM)

MA 00105

FRENCH RIVER BASIN
CHARLTON, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION
PROGRAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

BRIEF ASSESSMENT

Identification No.: MA00105

Name of Dam: Granite Reservoir Dam (AKA South Charlton
Reservoir Dam)

Town: Charlton

County and State: Worcester County, Massachusetts

Stream: Potters Brook, Tributary of the Little River

Date of Inspection: November 27, 1978

Granite Reservoir Dam is a 615-foot long, 18-foot high earthfill dam. The dam, which was originally built about 1850, had major repairs to the embankment and spillway in 1943 and 1956. The downstream face of the dam is a vertical dry stone masonry wall. The upstream face is an earthen slope, except in the vicinity of the outlet works, where there is a concrete headwall. The spillway, which is located about 250 feet from the right abutment of the dam, consists of a concrete weir with a slightly rounded crest and a broad concrete apron. The length of the weir is 66 feet and is at elevation (El) 631.0. The downstream face of the weir is a concrete and stone cascade which leads to a rectangular stilling basin. The outlet for the dam is a 2-foot square box conduit through the embankment and is located about 125 feet northeast of the spillway. Flow through the conduit is controlled by a 3-foot-square wooden sluice gate. The gate mechanism is a handwheel located on a concrete platform which overhangs the upstream face of the dam. Discharge from the spillway joins the outlet discharge about 20 feet downstream of the dam.

There are deficiencies which must be corrected to assure the continued performance of this dam. This conclusion is based upon the visual inspection at the site, the available engineering data, and limited evidence of operating and maintenance procedures.

GRANITE RESERVOIR DAM

Generally, the dam is in poor condition. According to the Corps of Engineers guidelines for the classification of hazard potential, the dam has been placed in the "significant" hazard category.

The following are visible signs of distress which indicate a potential hazard at the site: a severe bulge in the downstream stone masonry wall of the dam; leakage through the outlet conduit and through the masonry wall in the vicinity of the bulge; possible damage to the outlet gate; seepage below the toe of the embankment; erosion at several locations on the dam embankment and along the outlet channel; dense growth of trees and brush at the dam and along the discharge channels; and minor deterioration of the concrete on the spillway.

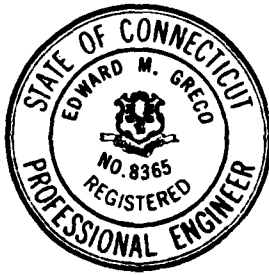
Hydraulic analyses indicate that the spillway at the dam can discharge a flow of 1,070 cfs with the water surface at El 634.4 which is the low point on the crest of the dam. An outflow test flood (one-half the probable maximum flood) of 2,800 cfs at El 635.7 will overtop the dam by 1.3 feet. The spillway can discharge 38 percent of the test flood.

It is recommended that the Owner employ the services of a qualified consultant to investigate the bulge in the wall and the seepage, and to evaluate the stability of the dam. In addition, the Owner should accomplish the following: repair the sluice gate at the outlet; backfill and protect the eroded area of the discharge channels; and repair the concrete on the spillway. The Owner should also implement a systematic program of inspection and maintenance.

The recommendations and remedial measures outlined above and in Section 7 should be implemented by the Owner within a period of one year after receipt of this Phase I Inspection Report. The Owner should open the sluice gate whenever the reservoir level exceeds El 631.0. The reservoir should be maintained

GRANITE RESERVOIR DAM

at this level until the recommended work has been completed. An alternative to these recommendations would be to breach the dam and drain the reservoir.



A handwritten signature in cursive script, reading "Edward M. Greco".

Edward M. Greco, P.E.
Project Manager
Metcalf & Eddy, Inc.

Connecticut Registration
No. 08365

Approved by:

A handwritten signature in cursive script, reading "Stephen L. Bishop".

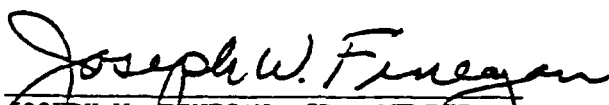
Stephen L. Bishop, P.E.
Vice President
Metcalf & Eddy, Inc.

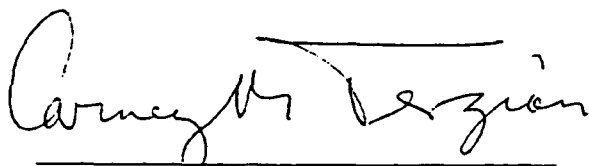
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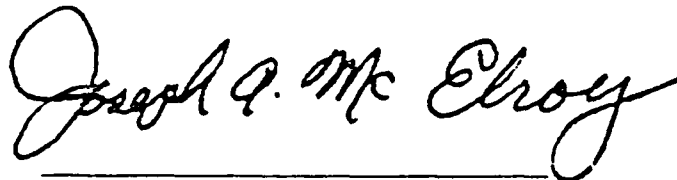


GRANITE RESERVOIR DAM

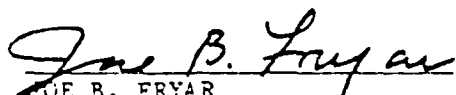
This Phase I Inspection Report on Granite Reservoir Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.


JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division


CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division


JOSEPH A. MCELROY, CHAIRMAN
Chief, NED Materials Testing Lab.
Foundations & Materials Branch
Engineering Division

APPROVAL RECOMMENDED:


JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in Recommended Guidelines for Safety Inspection of Dams, for a Phase I Investigation. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general conditions and the downstream damage potential.

GRANITE RESERVOIR DAM

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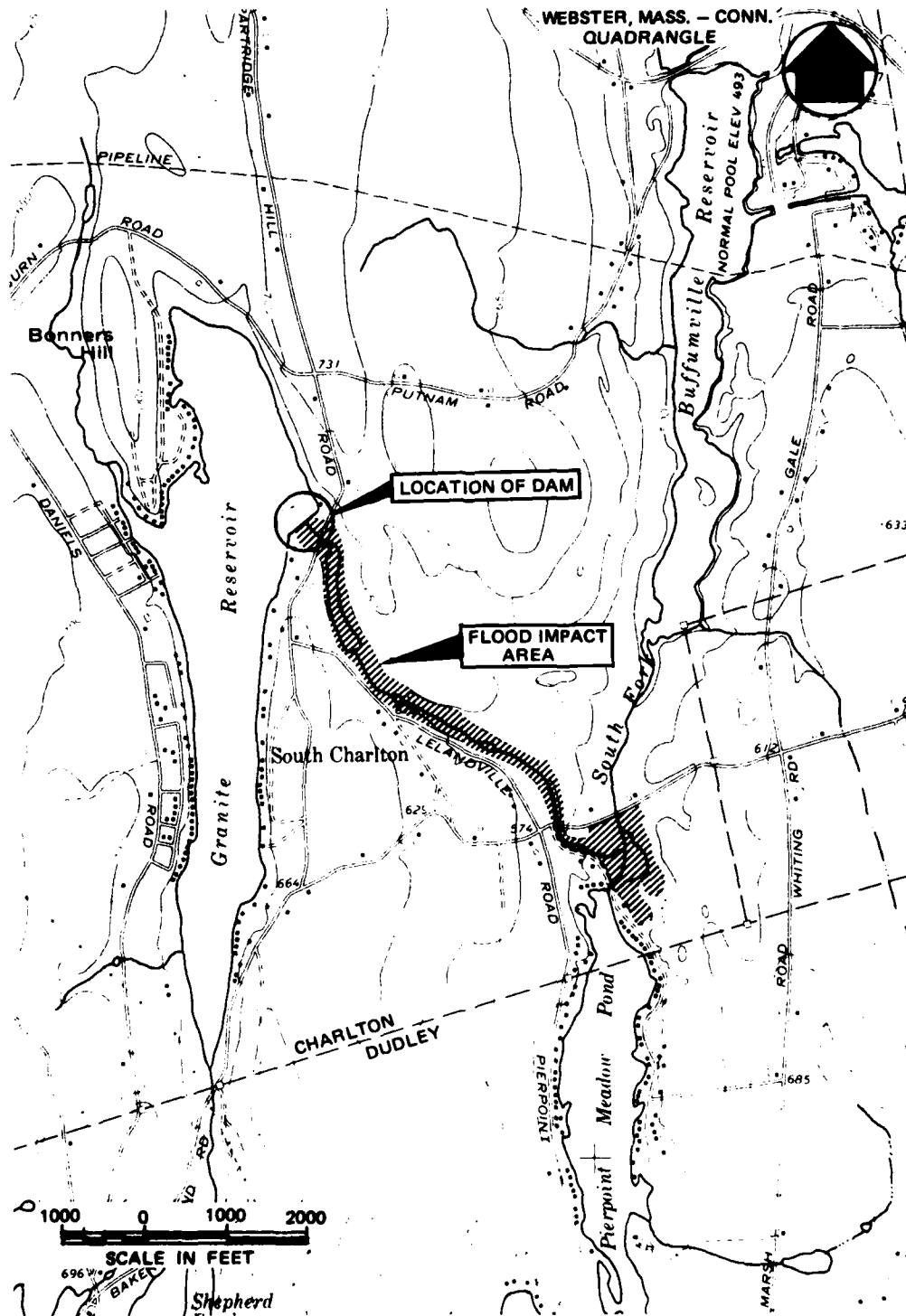
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OVERVIEW
GRANITE RESERVOIR (SOUTH CHARLTON RESERVOIR)
CHARLTON, MASSACHUSETTS





LOCATION MAP - GRANITE RESERVOIR DAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

GRANITE RESERVOIR
(SOUTH CHARLTON RESERVOIR)

SECTION 1

PROJECT INFORMATION

1.1 General

- a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Metcalf & Eddy, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Contract No. DACW 33-79-C-0016 dated November 28, 1978 has been assigned by the Corps of Engineers for this work.
- b. Purpose:
 - (1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.
 - (2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.
 - (3) Update, verify and complete the National Inventory of Dams.

GRANITE RESERVOIR DAM

1.2 Description of Project

- a. Location. The dam is located on Potters Brook, a tributary of the Little River, in the Town of Charlton, Worcester County, Massachusetts (see location map). The reservoir is known as the South Charlton Reservoir by the Owner and by local residents.
- b. Description of Dam and Appurtenances. Granite Reservoir Dam is an earthfill dam 615 feet long and 18 feet high (see Figure B-1). The crest of the dam is 15 to 25 feet wide and covered with brush and grass. The elevation of the crest varies from 634.4 to 635.8. Both abutments tie into natural ground, and the right abutment is adjacent to a residential lot.

For most of its length, the embankment southwest (right) of the spillway has upstream and downstream earth slopes of approximately 1.5:1. The upstream face is covered with riprap and the downstream face is wooded. The steep earth slope of the downstream face of the embankment is replaced by a vertical, dry-stone masonry wall about 45 feet southwest of the spillway.

The embankment northeast (left) of the spillway is constructed on an upstream earth slope of 1:1, and a vertical downstream stone masonry rubble wall. A concrete headwall is located on the upstream face of the dam in the vicinity of the outlet, and extends back approximately 5 feet into the embankment on either side of the outlet.

The approach to the spillway has concrete wing walls 2 feet thick and 12 feet long. The floor of the channel is sand and gravel partially covered with riprap. Figure B-3 in Appendix B shows a 1-foot thick concrete cutoff wall that extends below the crest of the weir to an unknown depth. In 1975, R.H. White Construction Company reportedly added a 3-foot deep, wedge-shaped concrete wall upstream of the weir. The approach was then backfilled with soil to restore the gradual slope of the channel.

GRANITE RESERVOIR DAM

The wing walls of the approach channel continue as 4-foot thick concrete side walls on the spillway. A second concrete wall was recently constructed at the base of the left side wall to prevent further deterioration of the concrete in this area. The spillway consists of a concrete weir with a slightly rounded crest and a broad concrete apron over stone masonry. The weir is 66 feet long at the crest which is at El 631.0, or 3.8 feet below the top of the side walls. The concrete apron extends 13 feet downstream in a gentle slope, then drops steeply to El 626.2, at the top of the cascade section. At this point, the width of the weir is reduced to 56 feet. The cascade was repaired after the 1955 flood and consists of an upper stepped stone section, and a lower concrete apron which slopes into the stilling basin at the toe. The stilling basin is a rectangular pool approximately 30 feet wide by 80 feet long and 4 feet deep, and lined with riprap. The pool discharges from the left end into a 5-foot wide earth channel that parallels the axis of the dam for about 80 feet. Rubble stone dumped at the base of the downstream wall of the dam protects the toe and the north bank of the channel from erosion. The low south bank of the discharge channel is natural ground overgrown by brush and trees. The spillway discharge channel joins the main stream channel below the outlet (see Figure B-1).

The outlet for Granite Reservoir is located about 125 feet northeast of the spillway. Figure B-4 shows a plan and sections of the outlet works as rebuilt in 1943. The gate house was recently removed, however, and replaced by a chain link fence and locked gate. The fence encloses a 7-foot-square platform and the gate operating mechanism. The platform overhangs the upstream face of the dam which consists of a concrete headwall anchored into the existing stone wall. The handwheel on the platform operates a 3-foot by 3-foot wooden gate that slides in keyways in the headwall.

GRANITE RESERVOIR DAM

The inlet to the outlet conduit is a 2-foot-square opening at the base of the stone wall. A trash rack is located on the headwall to the inlet. The conduit is a stone sluiceway approximately 25 feet long, and the outlet is located in the vertical stone masonry wall at the downstream face of the dam. The invert of the outlet is at El 616.3.

- c. Size Classification. Granite Reservoir Dam is classified in the "intermediate" category because it has a maximum height of 20 feet and a maximum storage capacity of 1,710 acre-feet.
- d. Hazard Classification. There is one house adjacent to the right abutment of the dam. The area below the dam is wooded and undeveloped, except for Partridge Hill Road, which crosses the stream about 265 feet downstream.

There are two small earth and stone masonry dams downstream of Granite Reservoir, between Partridge Hill Road and Pierpont Meadow Pond. Development along the stream is limited to one house. Water released from the reservoir due to the failure of the dam would flood the woodland below the dam and overtop Partridge Hill Road. The flood wave resulting from failure of the dam would be confined to the narrow stream valley for a distance of about a mile before entering the floodplain for Buffumville Reservoir. The house on the south side of the stream valley could be subject to some flood damage. There is also a potential for flood damage to the residences along the easterly shore of Pierpont Meadow Pond. Although the pond drains into Buffumville Reservoir via a triple concrete culvert, the flood wave from Granite Reservoir could back up into the pond and cause local flooding.

Because of this potential hazard to downstream property, the dam is placed in the "significant" hazard category.

- e. Ownership. The dam is owned by the Town of Charlton, Massachusetts (617-248-5900). Mr. Leonard Haebler, Chairman of the Board of

GRANITE RESERVOIR DAM

Selectmen, granted permission to enter the property and inspect the dam.

- f. Operators. The dam is operated by the Highway Superintendent for the Town of Charlton. The fence enclosing the gate works, and the handwheel on the gate stem, are both padlocked to prevent unauthorized use.
- g. Purpose of Dam. The dam and pond originally stored process water for use in the textile industry. The earliest recorded owners are the Stevens Linen Works, and the Dodge Felt Company. The Slater Company, also of Webster, was listed as a joint owner of the dam. Subsequent owners were the American Woolen Company and Textron, Inc. The Town of Charlton acquired the property about 1956. The reservoir has been used solely for recreation for many years.
- h. Design and Construction History. The date of the original construction of this dam is unknown, but is assumed to be about 1850. The first record of inspection is by the Worcester County Commissioners, dated 1923. The report describes a dry stone masonry wall and earth embankment. There is a bulge in the downstream wall that was noted as early as 1928; and also a leak in the wall about 20 feet west of the spillway. Repairs to both these areas were recommended at that time.

Reports from 1931 to 1941 stated that the dam was in poor condition. There was a leak through the spillway (which apparently had an apron of wood timbers) and through the outlet gate, which would not close properly. It was recommended that the gate be left open permanently to lower the reservoir.

In 1943, plans for alterations to the spillway and gate structure were submitted to the County on behalf of the American Woolen Company (see Figures B-3 and B-4). The changes included installing a concrete cutoff wall across the approach to the spillway, adding concrete wing walls, and raising the existing stone side walls of the spillway with concrete. The earth embankment was to be

GRANITE RESERVOIR DAM

leveled at the same time. According to Figure B-5, the plan was to eventually raise the embankment to the height of the new side walls. The gate house was rebuilt, and a new concrete headwall added to the upstream face of the dam. This replaced the curved stone wall on either side of the outlet works.

The dam and spillway sustained damages during the 1955 flood. The embankment was reportedly washed out at the downstream side opposite the gate house. Although the downstream wall was undisturbed, the County Inspector directed that the washout be backfilled with "clay and loam". Also, the three bottom steps of the spillway cascade, which were also washed away, had to be replaced with concrete. Figure B-2 shows the extent of the 1956 repairs to the spillway and also the location of the riprap which was added to the stilling pool.

Since 1955, the Worcester County Inspectors have reported that the spillway capacity was inadequate. The May, 1964, inspection report recommended either building an auxiliary spillway or enlarging the existing one which had been built in 1956. The report further stated that the embankment was covered with brush and trees and that the downstream wall was bulging in two places. Also, two small leaks were noted 100 feet from the easterly (northeast) end of the dam.

The most recent repair work on the dam was completed in 1975 by R.H. White Construction Company. The wooden sluice gate was rebuilt according to the 1943 design, and the gate house was torn down and replaced by the chain link fence. Fill, concrete and riprap were added to the upstream face of the dam in the vicinity of the outlet. A trash rack was installed in front of the sluice gate.

At the spillway, the contractor reportedly cut a 3-foot deep trench upstream of the crest of the weir, poured a wedged-shaped concrete wall and backfilled the approach with soil. A representative for R.H. White does not recall exposing the concrete cutoff beneath the crest

GRANITE RESERVOIR DAM

of the weir. The purpose of the new wall was to prevent seepage beneath the cap of the weir where the concrete had deteriorated. Also, to prevent further deterioration of the concrete side wall, a second, lower concrete wall was attached to the base of the left side wall of the weir.

The Town of Charlton has recently engaged R.H. White to investigate the leakage through the outlet gate. According to the Contractor's representative, the necessary repair work will be underway shortly.

Apparently no repair work has been scheduled for the bulging downstream wall.

- i. Normal Operating Procedures. The outlet gate is occasionally opened by the Highway Superintendent to lower the level of the reservoir and thereby allow the local residents to work on their waterfront property. Under normal conditions, the gate is kept closed.

1.3 Pertinent Data

- a. Drainage Area. The approximately 5,008 acre (7.82 square miles) drainage area includes the drainage to Shepherd Pond and Gore Pond located less than 2 miles south and southwest of the dam, on an unnamed stream. Approximately 25 percent of the watershed is hilly woodland and steep slopes. The remaining area includes fewer hills and a higher percentage of swamps and ponds than the northern portion. There is light residential development along the west and southeast sides of the reservoir. Recent residential construction is in evidence along Coburn Road and Daniels Road, northwest of Granite Reservoir. Elsewhere the drainage area is sparsely developed.
- b. Discharge. Normal discharge is over the ungated spillway, down the concrete and stone cascade, and into the rectangular stilling basin at the toe. The spillway has a broad, slightly rounded concrete crest at El 631.0. The crest is 66 feet long. The toe of the cascade is at El 617.3. The stilling basin is

GRANITE RESERVOIR DAM

approximately 80 feet long and a maximum of 30 feet wide. The channel flows parallel to the dam axis. The toe of the dam is protected from channel erosion by rubble masonry dumped on the north bank of the discharge channel. The south bank is natural ground covered with trees and brush. The discharge channel joins the main channel at the outlet from the reservoir and continues flowing southwest through a flat, wooded area. At 265 feet below the dam, the stream enters a concrete box culvert under Partridge Hill Road, and then flows into a small pond.

The spillway can discharge an estimated 1,070 cfs with the water surface at El 634.4, which is the approximate low point on the crest of the dam. The outflow test flood of 2,800 cfs (one-half the PMF) will overtop the dam by about 1.3 feet. The spillway can discharge 38 percent of the test flood.

The maximum flood level at the dam is unknown. Early inspection reports indicate that the embankment behind the downstream stone wall sustained some damage during the 1955 floods. The dam was not overtopped in the 1938 flood, apparently because the outlet gate had been opened for some time and the water level in the reservoir was down prior to the storm.

- c. Elevation (feet above Mean Sea Level (MSL)).
A benchmark was established at El 631.0 on the crest of the spillway. This elevation was obtained from a U.S. Geological Survey topographic map.

- (1) Top dam: 634.4 to 635.8
- (2) Test flood pool: 635.7
- (3) Design surcharge : Unknown
- (4) Full flood control pool: Not Applicable (N/A)
- (5) Recreation pool: 631.0
- (6) Spillway crest (ungated): 631.0

GRANITE RESERVOIR DAM

(7) Upstream portal invert diversion tunnel:
N/A

(8) Stream bed at centerline of dam: 615.0

(9) Maximum tailwater: 616.0

d. Reservoir

(1) Length of maximum pool: 9,300 feet

(2) Length of recreation pool: 9,300 feet

(3) Length of flood control pool: N/A

e. Storage (acre-feet)

(1) Test flood surcharge (Net): 973 at El
635.7

(2) Top of dam: 1,710

(3) Flood control pool: N/A

(4) Recreation pool: 1,010 (Approximate)

(5) Spillway crest: 1010

f. Reservoir Surface (acres)

*(1) Top dam: 207

*(2) Test flood pool: 207

(3) Flood-control pool: N/A

(4) Recreation pool: 207

(5) Spillway crest: 207

g. Dam

(1) Type: earthfill and stone masonry wall

(2) Length: 615 feet

*Based on the assumption that the surface area will not increase significantly with changes in reservoir elevation from 631.0 to 634.4.

GRANITE RESERVOIR DAM

- (3) Height: 18 feet
- (4) Top width: 15 to 25 feet
- (5) Side slopes: upstream - 1.5:1
downstream - vertical wall
- (6) Zoning: Unknown
- (7) Impervious core: earth
- (8) Cutoff: concrete cutoff trench across upstream end of spillway
- (9) Grout curtain: Unknown

1. Spillway

- (1) Type: concrete, slightly rounded, broad crest; concrete and masonry cascade and apron
- (2) Length of weir: 66 feet at crest;
effective length: 56 feet
- (3) Crest elevation: 631.0 MSL (assumed benchmark)
- (4) Gates: None
- (5) Upstream channel: concrete wing walls; 3-foot deep concrete wall built across upstream end of spillway apron, back-filled with soil
- (6) Downstream channel: rectangular, riprapped stilling basin at toe of concrete apron, approximately 30 by 80 feet; empties into discharge channel which flows parallel to dam and joins main stream below outlet
- (7) General: stream channel flows in concrete box culvert under Partridge Hill Road, 265 feet downstream of dam.

- j. Regulating Outlets. The regulating outlet at the dam is a 2-foot-square stone box conduit through the dam, 125 feet northeast of the

GRANITE RESERVOIR DAM

spillway. The conduit is shown on the drawings to be 45 feet long with an invert at El 616.3 at the outlet. The inlet to the conduit is located on the upstream face of the dam, and the outlet is at the toe of the vertical downstream wall of the dam. Flow is controlled by a 3-foot-square wooden slide gate keyed into a concrete headwall on the upstream face. The gate is operated by a handwheel located on a concrete platform overhanging the headwall.

The outlet can discharge approximately 84 cfs with the water level at El 631.0. At this rate, it would take approximately 30 hours to lower the reservoir 1 foot.

GRANITE RESERVOIR DAM

SECTION 2
ENGINEERING DATA

- 2.1 General. Four sheets of drawings were obtained from the Worcester County Commissioners' Office. One is dated December, 1955, and shows the proposed repairs to the spillway as designed by Chas. T. Main, Inc. The other three drawings are dated July, 1943, and indicate the proposed alterations to the outlet gate and spillway, and also a plan for releveing the embankment. Copies of these drawings are included in Appendix B. No other plans, specifications, or drawings are available from the Owner, State, County or Chas. T. Main, Inc. relative to the design, construction, or repair of this dam.

We acknowledge the assistance and cooperation of personnel of the Massachusetts Department of Public Works: Messrs. Willis Regan and Raymond Rochford, and of the Massachusetts Department of Environmental Quality Engineering, Division of Waterways: Messrs. John J. Hannon and Joseph Iagallo.

Also, we acknowledge the cooperation and assistance of personnel from the Worcester County Engineer's Office: Messrs. John O'Toole and Joseph Brasauskas.

Mr. David White, of R.H. White Construction, provided information on recent repairs made to the dam and appurtenances.

In addition, we thank Mr. Leonard Haebler, Chairman of the Charlton Board of Selectmen, who provided some information on the operation and past performance of the dam.

- 2.2 Construction Records. The only construction records are the 1955 and 1943 Plans referred to in Section 2.1 and included in Appendix B. There are no as-built drawings for the dam, spillway or outlet structures.
- 2.3 Operating Records. No operating records are available, and there is no daily record kept of the elevation of the pool or rainfall at the dam site.

GRANITE RESERVOIR DAM

2.4 Evaluation

- a. Availability. There is limited engineering data available.
- b. Adequacy. The lack of detailed hydraulic, structural, and construction data did not allow for a definitive review. Therefore, the evaluation of the adequacy of this dam is based on review of available drawings, visual inspection, past performance history, and engineering judgment.
- c. Validity. Comparison of the available drawings and oral report by R.H. White Construction Company with the field survey conducted during the inspection indicates that the information is valid for a Phase I assessment.

GRANITE RESERVOIR DAM

SECTION 3
VISUAL INSPECTION

3.1 Findings

- a. General. The Phase I Inspection of the dam at Granite Reservoir was performed on November 27, 1978. A copy of the inspection checklist is included in Appendix A. Previous inspections of this dam have been made by others since 1923. A partial listing of these inspections is in Appendix B. Also included in Appendix B are copies of inspection reports by both the Worcester County Commissioners' office and the Massachusetts Department of Public Works.
- b. Dam. The dam consists of left and right earth embankment sections separated by a concrete and stone masonry spillway. The embankment to the left of the spillway is in very poor condition. Although the riprap on the upstream face appears to be in place, there is some evidence of undermining near the left abutment. The crest is uneven, and overgrown with grass and brush, particularly at the top of the upstream slope.

The most severe sign of distress is the bulge in the vertical downstream stone masonry wall of the left embankment. A foot of horizontal displacement for the full height of the wall was observed in the area of the outlet. Also, some of the stone blocks in the bulging area show shear cracks which appear to be a sign of vertical movement in the wall.

The entire downstream wall is comprised of rough cut stone blocks with large voids between the blocks. In areas where smaller stones were used to fill in the spaces, some of those stones are dislodged from the wall. A large block has completely fallen out of the wall at the toe of the embankment near the left abutment.

GRANITE RESERVOIR DAM

Erosion of the embankment is apparent in the area adjacent to the left sidewall of the spillway. Erosion at the toe of the wall along the spillway discharge channel is prevented by the stone rubble dumped along the edge of the channel.

There are two areas of seepage below the embankment. Water is leaking through the toe of the wall on either side of the outlet, in the vicinity of the bulge. The seepage has left an orange stain on the rocks at the base, and some sand is visible in the seepage pool.

The other area of seepage is along a 25-foot section of the toe about one-half way between the outlet and the left abutment. The ground is wet and soft in this area, although the source of the seep is not visible.

There are signs of erosion on the upstream slope of the embankment to the right of the spillway, particularly in the right abutment, and adjacent to the right training wall of the spillway. There is some riprap near the bottom of the slope at the present water line. However, the upper slope is unprotected and the crest of the dam has apparently been eroded due to wave, ice or frost action. There are a number of trees growing on this embankment, and in this area the soil has been washed away, exposing the tree roots.

The downstream face of the right embankment is sloped for about one-half the length of the embankment. The remaining portion is a vertical stone retaining wall. The slope is very steep and covered with brush and trees ranging from 6 to 36 inches in diameter. There is very little grass cover on this slope and some erosion is evident. An animal burrow is visible on the slope near the stone wall. At the junction of the embankment with the stone masonry retaining wall, some stones forming the upper part of the wall have been dislodged. Brush cut from the crest of the dam in this area has been dumped at the toe of the wall.

GRANITE RESERVOIR DAM

There are signs of seepage in several places below the right embankment. There is a small pool of water in the low spot below the right abutment. Elsewhere along the toe, the ground is wet and soft.

- c. Appurtenant Structures. The spillway is in fair condition. The main sign of distress is the deterioration of the concrete. There is some spalling and exposed reinforcing on the right side wall near the water line. The new concrete wall attached to the left side is in good condition, as is the concrete wedge that was cast to prevent seepage underneath the crest of the weir. There is some cracking and efflorescence in the concrete apron above and below the stepped stone cascade. Weathering has exposed the aggregate in the concrete and there is also minor staining at the water line. The stone section is in fair condition. Only patches of mortar remain in the joints between the stone steps, and there are a few free-standing blocks on the left side of the cascade.

The outlet conduit is a 2-foot-square stone box conduit which extends through the dam about 125 feet northeast of the spillway. The concrete headwall at the inlet is in fair to poor condition. There are many cracks in the concrete, one showing up to 1/4-inch displacement. Slumping and erosion of the slope above the headwall is apparent. Boulders and fill have been recently dumped in this area to prevent further erosion. The concrete platform supporting the gate mechanism is in good condition, although there is some exposed aggregate and minor staining from the chain-link fence. The handwheel was not tested, although it appeared to be in good condition. A representative for the Town of Charlton reported that the sluice gate did not close properly and a diver had been sent down to investigate the problem. At the time of the inspection, there was water discharging from the outlet and from the wall on each side of the outlet. This is also the area of the bulge in the stone wall.

GRANITE RESERVOIR DAM

- d. Reservoir Area. The area around Granite Reservoir is moderately developed with about 100 residences and summer cottages along the shore. Water supply to the homes is from groundwater wells located adjacent to the reservoir. Further residential development is likely, particularly in the subdivisions east of Daniels Road, which is on the west side of the reservoir. The rest of the area is wooded or farmland with moderate slopes of 5 to 20 percent.
 - e. Downstream Channel. Discharge from the stilling basin flows into a 5-foot wide channel which parallels the dam. The north bank is bounded by rubble stone overgrown with brush, and there are many trees overhanging the south bank. The discharge channel joins the main stream about 20 feet below the outlet. The main channel is approximately 20 to 30 feet wide, with a natural bed of sand, gravel and cobbles. The entire downstream area is relatively flat and heavily wooded. Some of the trees overhanging the stream have had the soil washed away from their roots. Erosion is particularly severe on the left bank of the channel, near the upstream end. The channel continues downstream for about 265 feet, and then flows into a concrete box culvert under Partridge Hill Road. Below the road the channel empties into a small pond which has been created by a second earth dam about 1,600 feet downstream of the road. Below the second dam, the flow continues downstream in a narrow, undeveloped valley until it reaches the floodplain of Buffumville Reservoir. In this section, the stream flows over exposed bedrock.
- 3.2 Evaluation. The above findings indicate that the dam is in poor condition, and there are several deficiencies which require attention. It is evident that the dam is not adequately maintained. Recommended measures to improve these conditions are stated in Section 7.3.

GRANITE RESERVOIR DAM

SECTION 4
OPERATION PROCEDURES

- 4.1 Procedures. Under normal conditions, the outlet gate at the dam is kept closed. The highway superintendent opens the gate occasionally to lower the water level in the reservoir, allowing local residents to work on their waterfront property.
- 4.2 Maintenance of Dam. The most recent repair work on the dam was completed in 1975. However, it was evident from the recent visual inspection that there is no regular maintenance program at the site. The bulge in the downstream wall and the condition of the masonry require attention. Erosion at various locations on the embankment has not been repaired. The dense growth of trees and brush on the crest and downstream slope of the embankment has not been controlled.
- 4.3 Maintenance of Operating Facilities. In 1975, R.H. White Construction demolished the former gate house and replaced the timbers on the sluice gate. Since that time, the gate has been damaged and will not close completely. The Town is currently trying to correct this problem. However, conditions at the downstream end of the outlet conduit have been deteriorating for years. Leaks in the vicinity of the outlet have been reported since 1940, and apparently no repair work was ever scheduled in this area.
- 4.4 Description of Any Warning System in Effect.
There is no warning system in effect at this dam.
- 4.5 Evaluation. There is no regular program of maintenance or warning system in effect at Granite Reservoir Dam. This is undesirable considering the dam is in the "significant" hazard category. A program of inspection and maintenance and a surveillance system for this dam should be implemented as recommended in Section 7.3.

GRANITE RESERVOIR DAM

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features.

- a. General. The drainage area to Granite Reservoir is characterized by numerous hills (up to El 1,004) in the north and by swamps and ponds in the southern section. Both areas are sparsely developed and heavily wooded. Gore Pond and Shepherd Pond are immediately upstream of the reservoir. There are no other major ponds in the watershed.

The total storage in Granite Reservoir is calculated to be 1,710 acre-feet. At the time of the inspection, the water level was 3 feet below the crest of the spillway. However, early inspection reports have noted that the water level frequently rose to within 1 foot of the top of the embankment in the late winter and spring. In the 1930's it was recommended that the outlet gate be kept open at all times to reduce the head on the embankment.

The stability of the dam and the adequacy of the single spillway has always been of concern to the inspectors. Were the dam to fail, the steep, relatively narrow discharge channel would rapidly conduct the flood wave to the floodplain of Buffumville Reservoir, with only minor channel storage, and a limited amount of flood damage.

- b. Design Data. There are no hydraulic computations available for this dam. A letter dated April 27, 1956, from the Worcester County Commissioners to Textron (the former owner) stated that Professor Hooper "checked the spillway capacity using the Kennison-Colby formula". It was determined that: "a flood spillway of 40 feet in length and 5 feet in depth is necessary for the safety of the dam". This was to be in addition to the existing spillway. The letter is on file at the Worcester County Commissioner's office. The maximum design flow for the dam is unknown.

GRANITE RESERVOIR DAM

- c. Experience Data Hydraulic records are not available for the dam. Early inspection reports were reviewed at the Worcester County Commissioners' Office. From one report it was learned that the dam was not overtopped in 1936 or 1938, apparently because the outlet gate had been open for some time "and the floods found the reservoir about half full of water". However, the embankment did sustain some damage due to overtopping in the 1955 floods, particularly in the area downstream of the gate house.
- d. Visual Observations. Discharge from Granite Reservoir is over a broad, slightly curved concrete crest of the spillway and down the concrete and stone masonry cascade to the stilling basin. The maximum length of the weir is 66 feet at the crest, and narrows to 56 feet at the top of the cascade (see Figure B-2). For the purpose of hydraulic computations, the 56-foot dimension should be considered the effective length of the spillway. Water from the stilling pool flows from the left side of the basin into a channel that runs parallel to the embankment for a distance of about 80 feet. The downstream slope of the stilling basin is built up with riprap, however, in the event of a major flood, the flow would probably bypass the discharge channel and overflow the far end of the basin.
- The discharge channel joins the main stream below the outlet. The gate which controls flow through the outlet is reportedly not closing properly. Leakage is evident through the outlet and through the wall on either side of the outlet. It is essential that the gate be maintained in good working condition, as it is necessary for controlling the water level in the reservoir.
- e. Test Flood Analysis. Granite Reservoir Dam has been classified as an intermediate size dam of significant hazard potential. According to the Corps of Engineers guidelines, either the one-half or full Probable Maximum Flood (PMF) should be used for evaluating the capacity of the spillway and dam. For this preliminary investigation, one-half the PMF was used.

GRANITE RESERVOIR DAM

The PMF rate was determined to be 950 cfs per square mile. This calculation is based on the average slope of the drainage area of 2 percent, the pond-plus-swamp area to drainage area ratio of 18 percent, and the U.S. Army Corps of Engineers' guide curves for Maximum Probable Flood Peak Rates (dated December, 1977). Applying one-half the PMF to the 7.82 square miles of drainage area results in a calculated peak flood flow of 3,700 cfs as the inflow test flood. By adjusting the inflow test flood for surcharge storage, the maximum discharge rate was established as 2,800 cfs (358 cfs per square mile), with a water surface at El 635.7.

Hydraulic analyses indicate that the existing spillway can discharge a maximum of 1,070 cfs with the water surface at El 634.4, which is approximately the low point on the crest of the dam. This discharge is 38 percent of the outflow test flood. The maximum head on the crest during peak outflow would be 1.3 feet, with a discharge of 3.78 cfs per foot of width. The depth at critical flow would be 0.76 feet with a velocity of 5.0 feet per second. With the pond level at the elevation of the spillway crest (631.0), the low level outlet can discharge about 84 cfs. It would take one hour to lower the water level 1 foot.

- f. Dam Failure Analysis. The peak discharge rate due to failure was calculated to be 13,400 cfs for a 104-foot long section of the earth and stone embankment. The maximum height of the flood wave is calculated to be 10 feet between the dam and the floodplain for Buffumville Reservoir.

The flood wave would probably overtop Partridge Hill Road and cause minor flooding of a house built on the south side of the stream, about 3,000 feet downstream of the dam. There are no other structures along the existing stream valley. However, there is a possibility of minor flood damage to the residences on the easterly side of Pierpont Meadow Pond. The pond drains into Buffumville Reservoir via a triple concrete culvert at the

GRANITE RESERVOIR DAM

north end. A part of the flood flow from Granite Reservoir could back up into Pierpont Meadow Pond and cause local flooding. For this reason, the dam has been placed in the "significant" hazard category.

GRANITE RESERVOIR DAM

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

- a. Visual Observations. The evaluation of the structural stability of Granite Reservoir Dam is based on review of available drawings and the visual inspection conducted on November 27, 1978. As discussed in Section 3, Visual Inspection, the dam is in poor condition. A bulge in the stone wall in the vicinity of the outlet has been noted in inspection reports for many years. This condition, combined with the leakage through the gate and on either side of the outlet indicates a potentially unstable situation. It is recommended that a more detailed investigation be conducted to evaluate the stability of the dam.
- b. Design and Construction Data. There are no plans, specifications or computations available on the design and construction of the original dam which is probably over 100 years old. Information does not appear to exist on the type, shear strength and permeability of the soil and/or rock materials of the embankment.

A cross-section on the 1955 drawing by Chas. T. Main, Inc. (Figure B-2) indicates that the original embankment in the vicinity of the outlet consisted of upstream and downstream rubble walls and an earthfill core. Figure B-3, which is dated 1943, shows a new concrete wall anchored to the stone wall on the upstream side. The concrete wall extends laterally into the embankment and vertically to the base of the gate structure. The wall was designed to prevent seepage through the outlet and to reinforce the embankment. However, during the 1955 floods, the embankment was partially washed out behind the downstream wall, directly opposite the gate house. The washout was cleaned out and rebuilt with a "clay and loam filling".

GRANITE RESERVOIR DAM

The 1943 drawings also show new concrete added to the spillway apron and side walls, and a 1-foot thick concrete cutoff wall that extends the length of the weir, at the upstream end. The depth of the cutoff is unknown.

In 1975, more fill and a concrete cover were added to the upstream slope of the embankment in the vicinity of the gate structure. There has not been any other work done on the embankment since that time.

- c. Operating Records. There is no instrumentation of any type in Granite Reservoir Dam, and no instrumentation was ever installed in this dam. The performance of this dam under prior loading can only be inferred by physical evidence at the site.
- d. Post-Construction Changes. There are no as-built drawings available for Granite Reservoir Dam. Information on post-construction changes as discussed in Section 6.1.b (above) was based on discussions with Chas. T. Main, Inc., and R.H. White Construction Company, and the visual evidence collected during the field inspection.
- e. Seismic Stability. The dam is located in Seismic Zone No. 2 and in accordance with Phase I "Recommended Guidelines" does not warrant seismic analysis.

GRANITE RESERVOIR DAM

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

- a. Condition. Based upon a review of the available drawings, the visual inspection of the site and limited operational or maintenance information, deficiencies have been identified which must be corrected to assure the continued performance of this dam. Generally, the dam is considered to be in poor condition. The following signs of distress were observed at the site: a severe bulge in the downstream stone masonry wall of the dam; leakage through the outlet and through the wall in the vicinity of the bulge; possible damage to the outlet gate; seepage below the toe of the embankment; erosion at several locations on the dam and along the outlet channel; dense growth of trees and brush on the crest, both slopes, and along the discharge channels; and minor deterioration of the concrete in the spillway.

Hydraulic analyses indicate that the spillway can discharge a flow of 1,070 cfs with the water surface at El 634.4 which is the low point on the crest of the dam. An outflow test flood of 2,800 cfs (one-half the probable maximum flood) will overtop the dam by a maximum of 1.3 feet. The spillway can discharge 38 percent of the test flood.

- b. Adequacy. The lack of detailed design and construction data did not allow for a definitive review. Therefore, the evaluation of the adequacy of this dam is based primarily on review of available drawings, visual inspection, past performance and engineering judgment.
- c. Urgency. The recommendations and remedial measures outlined below should be implemented by the Owner within one year after receipt of this Phase I Inspection Report.

GRANITE RESERVOIR DAM

- (6) repair the concrete on the spillway;
- (7) implement a systematic program of maintenance inspections. As a minimum, the inspection program should consist of a monthly inspection of the dam and appurtenances, supplemented by additional inspections during and after severe storms. All repairs and maintenance should be undertaken in accordance with all applicable State regulations;
- (8) continue periodic technical inspections of this dam on an annual basis;
- (9) institute a definite plan for surveillance and a warning system during periods of unusually heavy rains and/or runoff.

7.4 Alternatives. An alternative to implementing the recommendations and the maintenance procedures listed above would be to breach the dam and drain the reservoir.

GRANITE RESERVOIR DAM

PERIODIC INSPECTION

PARTY ORGANIZATION

PROJECT Granite Reservoir
(So. Charlton Reservoir)

DATE November 27, 1978

TIME 8:00 a.m.

WEATHER cold, overcast

W.S. ELEV. 628.0 U.S. 616.0 D.N.S.

Benchmark E1 631.0 at spillway
crest (assumed from U.S.G.S. map)

PARTY:

- | | |
|----------------------|-----------------------|
| 1. <u>E. Greco</u> | 6. <u>L. Branagan</u> |
| 2. <u>S. Pierce</u> | 7. _____ |
| 3. <u>B. Checchi</u> | 8. _____ |
| 4. <u>D. Cole</u> | 9. _____ |
| 5. <u>H. Lord</u> | 10. _____ |

| PROJECT FEATURE | INSPECTED BY | REMARKS |
|--------------------|-----------------------------|---------|
| 1. <u>Dam</u> | <u>E. Greco / S. Pierce</u> | |
| 2. <u>Spillway</u> | <u>L. Branagan</u> | |
| 3. _____ | | |
| 4. _____ | | |
| 5. _____ | | |
| 6. _____ | | |
| 7. _____ | | |
| 8. _____ | | |
| 9. _____ | | |
| 10. _____ | | |

PERIODIC INSPECTION CHECK LIST

PROJECT Granite Reservoir DATE 11/27/78
 PROJECT FEATURE Dam NAME E. Greco
 DISCIPLINE Geotechnical NAME S. Pierce

Note: d/s = downstream, u/s = upstream

| AREA EVALUATED | CONDITIONS |
|---|---|
| <u>DAM EMBANKMENT</u> | |
| Crest Elevation | 634.4 to 635.8 |
| Current Pool Elevation | 628.0 |
| Maximum Impoundment to Date | Unknown |
| Surface Cracks | not applicable |
| Pavement Condition | dirt path covered with brush some cut trees on upstream side |
| Movement or Settlement of Crest | none visible - crest uneven |
| Lateral Movement | bulge in d/s wall near outlet |
| Vertical Alignment | slightly irregular |
| Horizontal Alignment | relatively straight |
| Condition at Abutment and at Concrete Structures | ties into natural ground at both abutments right abutment: house and small beach left abutment: beach |
| Indications of Movement of Structural Items on Slopes | d/s stone wall: blocks show shear cracks in area of bulge at outlet structure |
| Trespassing on Slopes | d/s slope: animal burrow at base of stone wall, adjacent to right abutment |
| Sloughing or Erosion of Slopes or Abutments | d/s slope: erosion of embankment below d/s wall, adjacent to left training wall of spillway |
| Rock Slope Protection - Riprap Failures | u/s: riprap fair condition, some undermining near left abutment. d/s: vertical dry-stone wall, rubble rock dumped at toe between spillway and outlet. |
| Unusual Movement or Cracking at or near Toes | None visible; toe masked by cut brush and rock |
| Unusual Embankment or Downstream Seepage * | ① 20' below stone wall, to right of spillway ② below right abutment - standing water ③ 10' seepage area in vicinity of bulge at outlet |
| Piping or Boils | some sand visible in vicinity of seepage near outlet |
| Foundation Drainage Features | none |
| Toe Drains | none |
| Instrumentation System | none |

* ④ 25' wet section at toe, 1/2-way between outlet and left abutment

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PERIODIC INSPECTION CHECK LIST

PROJECT Granite Reservoir DATE 11-27-78
 PROJECT FEATURE outlet NAME E. Greco
 DISCIPLINE Geotechnical NAME S. Pierce

| AREA EVALUATED | CONDITION |
|---|--|
| <u>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</u> | |
| a. Approach Channel | No channel - concrete intake structure overhangs gate |
| Slope Conditions | - |
| Bottom Conditions | - |
| Rock Slides or Falls | - |
| Log Boom | - |
| Debris | - |
| Condition of Concrete Lining | - |
| Drains or Weep Holes | - |
| b. Intake Structure | 7'-square concrete intake structure concrete headwall on either side |
| Condition of Concrete | fair to poor: many cracks in headwall one showing 1/4" displacement ** |
| Stop Logs and Slots | trash gate |

* Chainlink fence encloses hand wheel for opening gate
 Slide gate accessible through metal plate in floor
 of concrete intake structure

** exposed aggregate, rust staining on concrete due to chainlink fence
 erosion at intersection of concrete box and headwall

c. Upstream headwall in vicinity of outlet: sloping and erosion of slope
 apparent. Boulders and fill dumped to protect area. Capped
 with concrete

PERIODIC INSPECTION CHECK LIST

PROJECT Granite Reservoir DATE 11-27-78
 PROJECT FEATURE Outlet NAME E. Greco
 DISCIPLINE Geotechnical NAME S. Pierce

| AREA EVALUATED | CONDITION |
|---|--|
| OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL | stone box conduit through dam 2' by 2' opening in dls wall. |
| General Condition of Concrete | N/a |
| Rust or Staining | some orange staining in vicinity of seepage |
| Spalling | n/a |
| Erosion or Cavitation | n/a |
| Visible Reinforcing | none |
| Any Seepage or Efflorescence | seepage at toe of wall, to left of outlet |
| Condition at Joints | n/a |
| Drain Holes | none |
| Channel | natural stream bed, joined by spillway channel ~ 50' below dls wall |
| Loose Rock or Trees Over- hanging Channel | no rock; many small trees overhanging channel, one large (36") pine on left bank |
| Condition of Discharge Channel | natural stone and gravel stream bed some erosion at left bank - under cut Channel passes under Partridge Hill Road ~ 250' below dam, in concrete box culvert. Culvert extends beyond road in 7' high 6m pipe. |

PERIODIC INSPECTION CHECK LIST

PROJECT Granite Reservoir DATE 11-27-78
 PROJECT FEATURE Spillway NAME L. Branagan
 DISCIPLINE Hydraulic NAME E. Greco

| AREA EVALUATED | CONDITION |
|--|--|
| <u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u> | |
| a. Approach Channel | Concrete apron and weir 24-inch wide concrete wingwalls in fair to poor condition - erosion at high water line, exposed reinforcing |
| General Condition | new concrete lip for apron - wooden forms still in place; backfilled approach channel |
| Loose Rock Overhanging Channel | none |
| Trees Overhanging Channel | trees at left spillway abutment |
| Floor of Approach Channel | sand, some minor riprap; trace erosion |
| b. Weir and Training Walls | concrete broad-crest weir, 8-step stone cascade and central concrete apron |
| General Condition of Concrete | fair - visible construction joints, cracking, aggregate exposed on d/s face of weir Traces of concrete between rocks at cascade |
| Rust or Staining | minor at base of d/s apron, at water line |
| Spalling | at base of training walls, and d/s face of weir (erosion?) |
| Any Visible Reinforcing | none |
| Any Seepage or Efflorescence | efflorescence at cracks in downstream apron |
| Drain Holes | none |
| c. Discharge Channel | broad rectangular stilling basin lined with riprap, channel runs parallel to dam to left of spillway |
| General Condition | fair |
| Loose Rock Overhanging Channel | none |
| Trees Overhanging Channel | many 1-2" trees, some 12" or greater 48" tree overhanging channel |
| Floor of Channel | few irregular large boulders |
| Other Obstructions | |

APPENDIX B

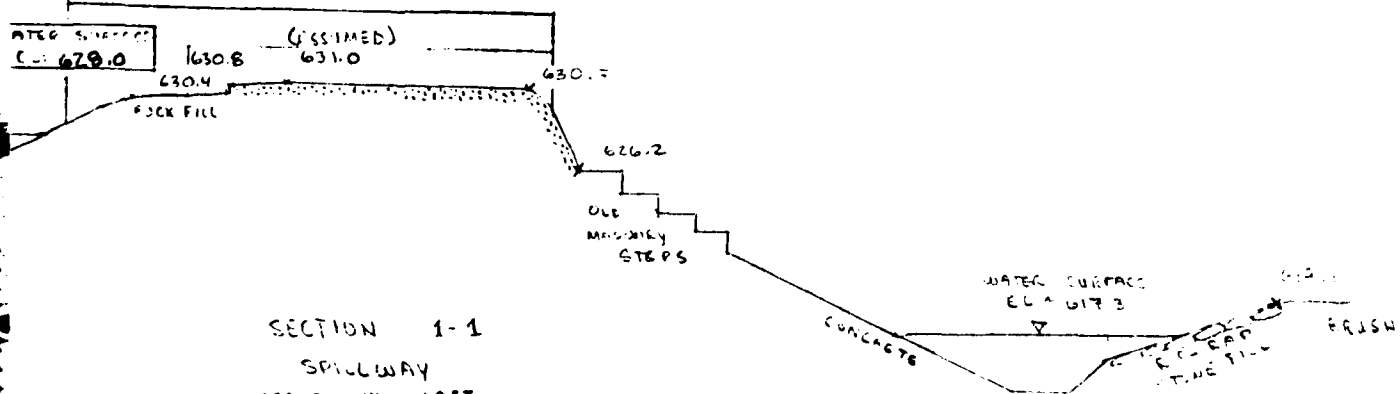
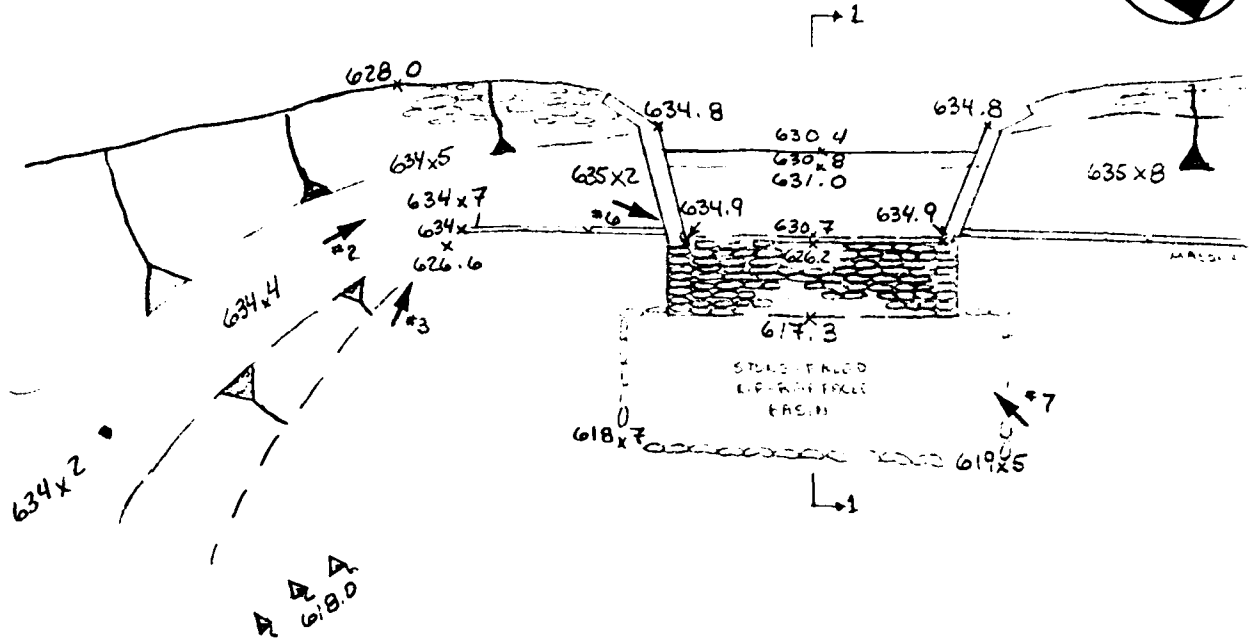
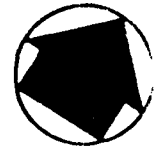
PLANS OF DAM AND PREVIOUS
INSPECTION REPORTS

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| Figure B-2 South Charlton Dam, Spillway Repair | B-2 |
| Figure B-3 Plan of Proposed Alterations to Spillway | B-3 |
| Figure B-4 Plan of Proposed Alterations to Gateway | B-4 |
| Figure B-5 Plan of Proposed Profile to Dam | B-5 |
| Previous Inspections (Partial Listing) | B-6 |
| Inspection by Mass. Department of Public Works, | B-7 |
| Order Issued by Worcester County Commissioners to Textron, Inc., September 6, 1956 | B-31 |

GRANITE RESERVOIR DAM

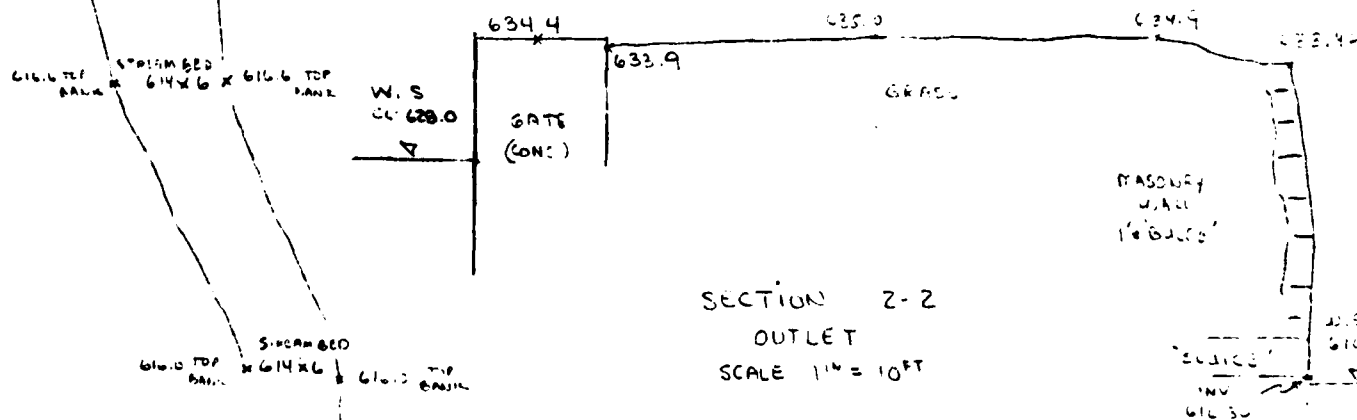
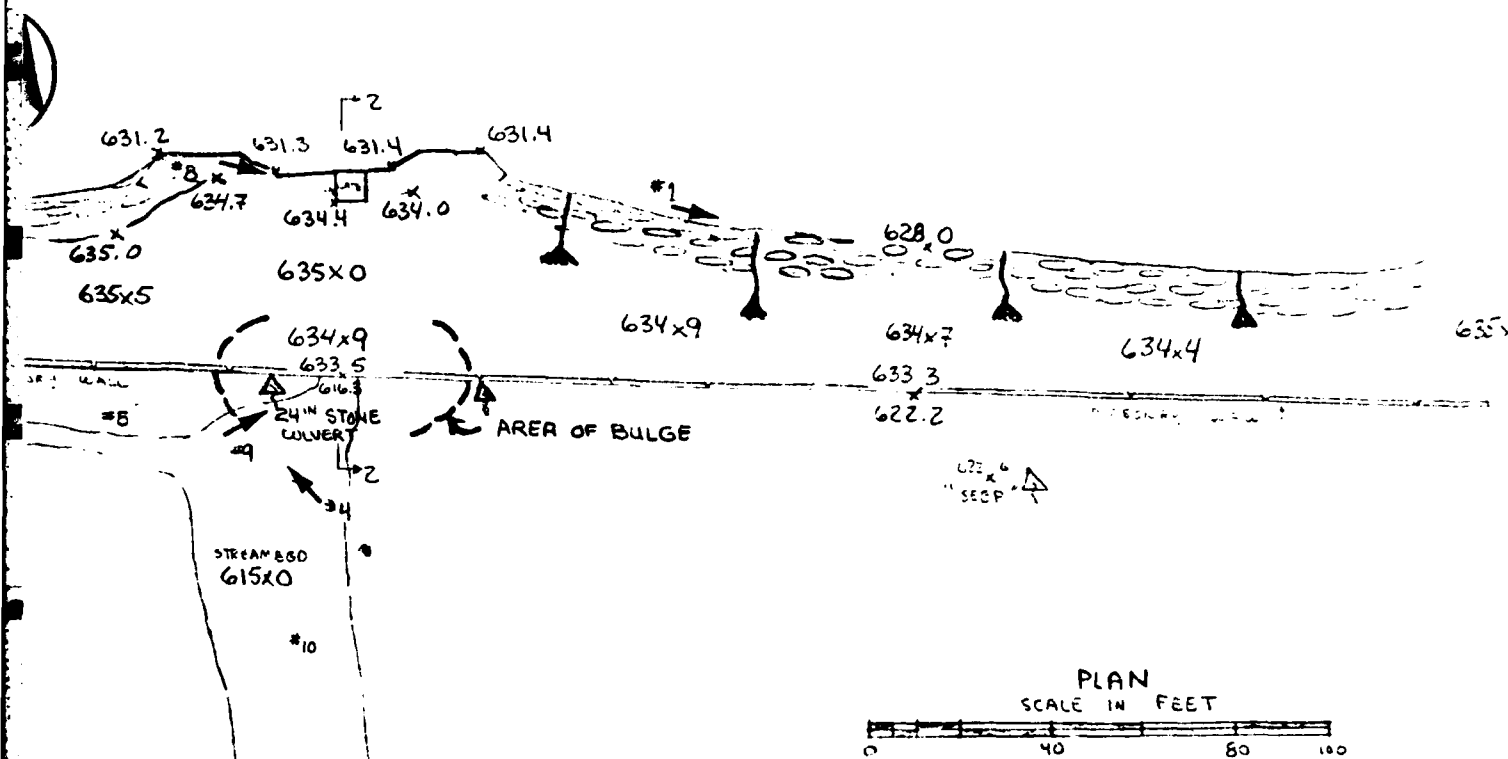
GRANITE RESERVOIR

WATER SURFACE ELEV. = 628.0



ELEVATIONS SHOWN ARE REFERENCED TO ASSUMED BENCHMARK ELEV. 631.0 (MSL) ON SPILLWAY CREST
 INFORMATION SHOWN BASED ON FIELD SURVEY OF NOVEMBER 27, 1978, AND WORCESTER COUNTY COMMISSION
 PROPOSED ALTERATIONS TO DAM AT SOUTH CHARLTON RESERVOIR, FOR AMERICAN WOOLLEN COMPANY, 2
 #2 DENOTES SEEPAGE
 #2 INDICATES LOCATION AND DIRECTION OF VIEW FOR PHOTOGRAPHS

ALF & EDDY, INC.



LOWERS PLAN OF
INC., JULY, 1943.

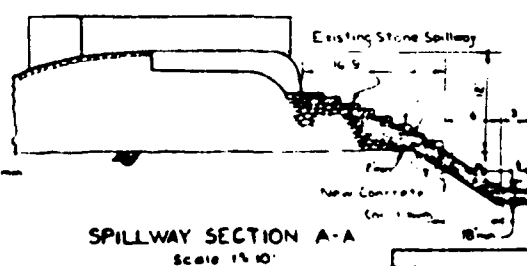
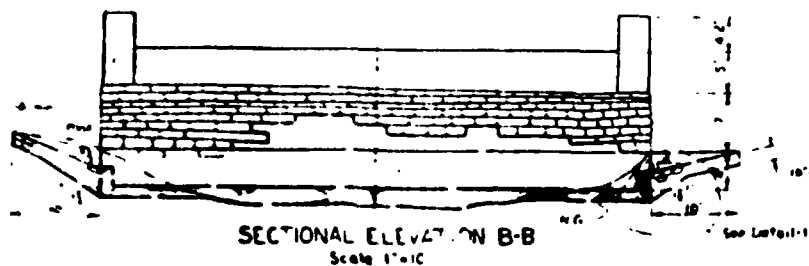
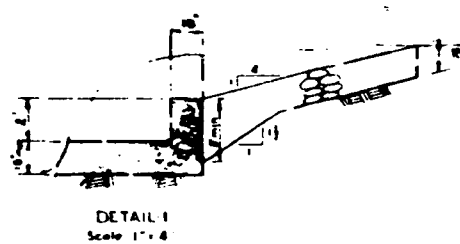
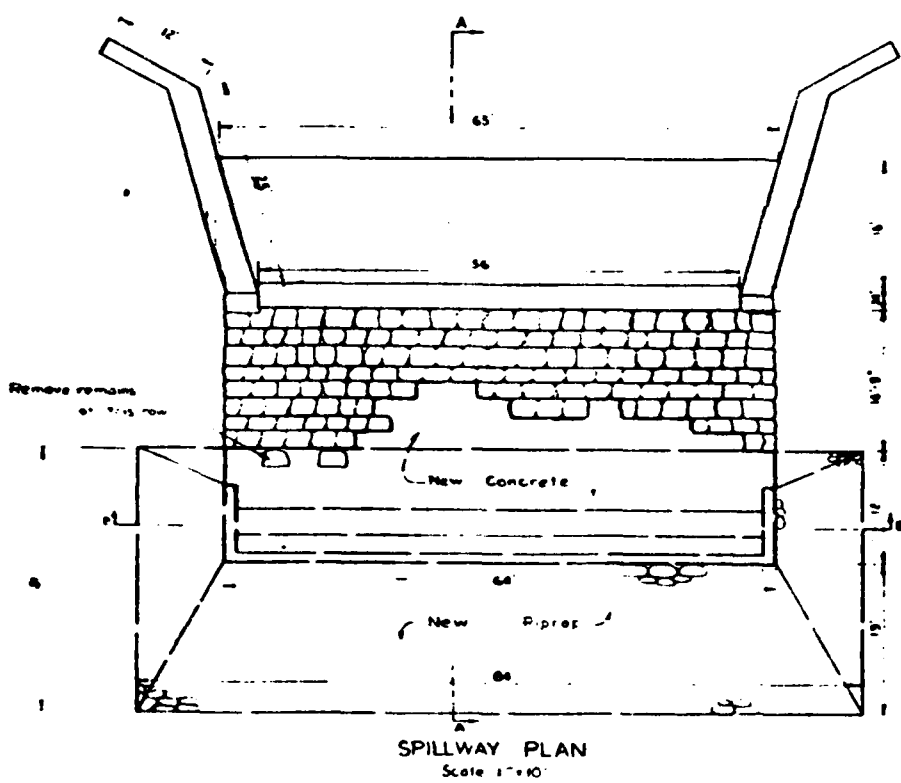
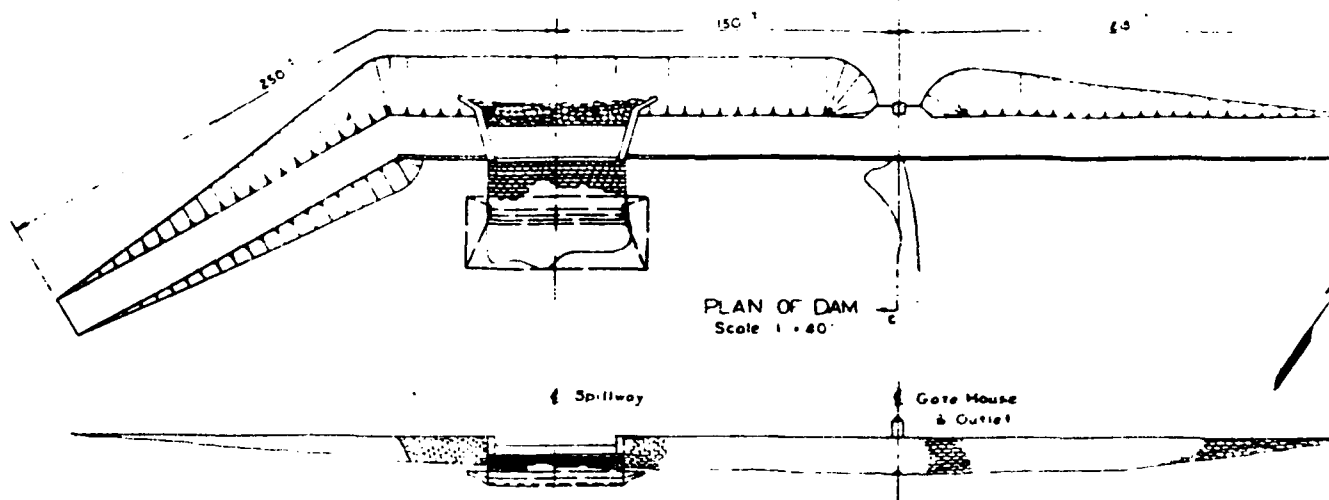
WATER SURFACE
EL: 615.8

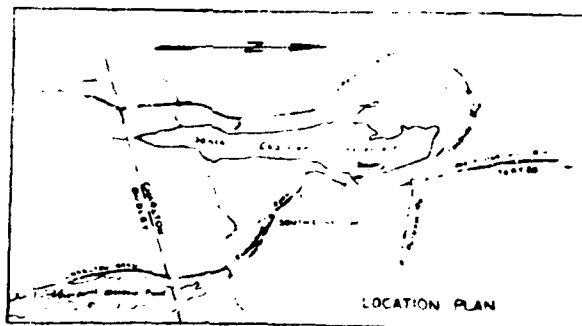
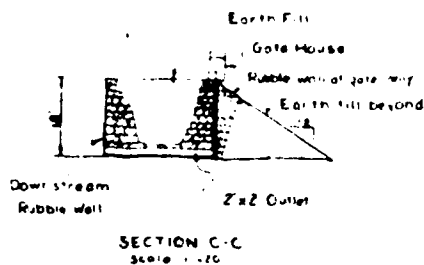
STREAM BED
614.2

EL: 614.2

PARTRIDGE HILL ROAD

| | |
|---|---------------------|
| NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS | |
| GRAYITE RESERVOIR DAM | |
| FIGURE B-1: PLAN OF DAM AND SECTIONS | |
| TRIBUTARY: FRENCH RIVER | MASSACHUSETTS |
| SCALE: AS SHOWN | DATE: JANUARY, 1979 |





SPECIFICATIONS

EXCAVATION

Under pool below spillway so that all work may be done in the dry.
Excavate to minimum lines shown, and to firm foundation.
Remove all loose stone in existing spillway taking care not to disturb remaining stone.

CONCRETE

Concrete shall have minimum compressive strength of 3000 psi at 28 days, shall contain not less than 5 1/2 sacks of cement per cubic yard, and not more than 6 1/2 gallons of water per sack of cement, including water carried by aggregate.
Aggregate shall consist of properly proportioned blend of graded sand and crushed stone or washed gravel. All to be clean, hard, durable, uncoated particles, free from dirt or other deleterious substance, 1 1/2" maximum size.
Cement shall be Portland Cement meeting the requirement of ASTM Type I.
Construction joints where required shall be located as shown.
The foundation shall be free of frost, standing water, any organic material, or mud when the concrete is placed.
The concrete shall be protected from freezing for a minimum of 72 hours after it has been placed.

RIPRAP

Riprap shall be hard and sound, and angular in shape.
Approximately 60% shall be from 2 to 2 1/2 cubic feet in volume, remainder shall be 1 to 2 cubic feet in volume.
Stone shall vary in size to form a compact mass with minimum voids when placed.

CLEANUP

Remove all material not a part of the completed structure, and grade adjacent area to approximately original grade.

NOTIFICATION AND INSPECTION

Notify the Worcester Co Commissioners before starting work. Work is subject to inspection and approval by County Engineer.

PLAN REDUCED APPROXIMATELY 50 %

LEGEND

Outline existing structure _____
Outline new work _____

AREA OF WATERSHED 853.56 MI.
AREA OF RESERVOIR 240 ACRES
CAPACITY OF RESERVOIR 3000 ACFT

TEXTRON AMERICAN
WEBSTER MILL WEBSTER, MASS

SOUTH CHARLTON DAM
SPILLWAY REPAIR

CHAS. T. MAIN, INC.

SCALE AS NOTED

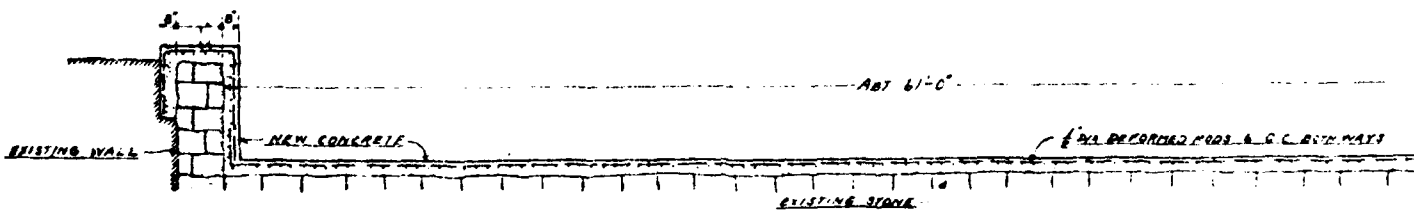
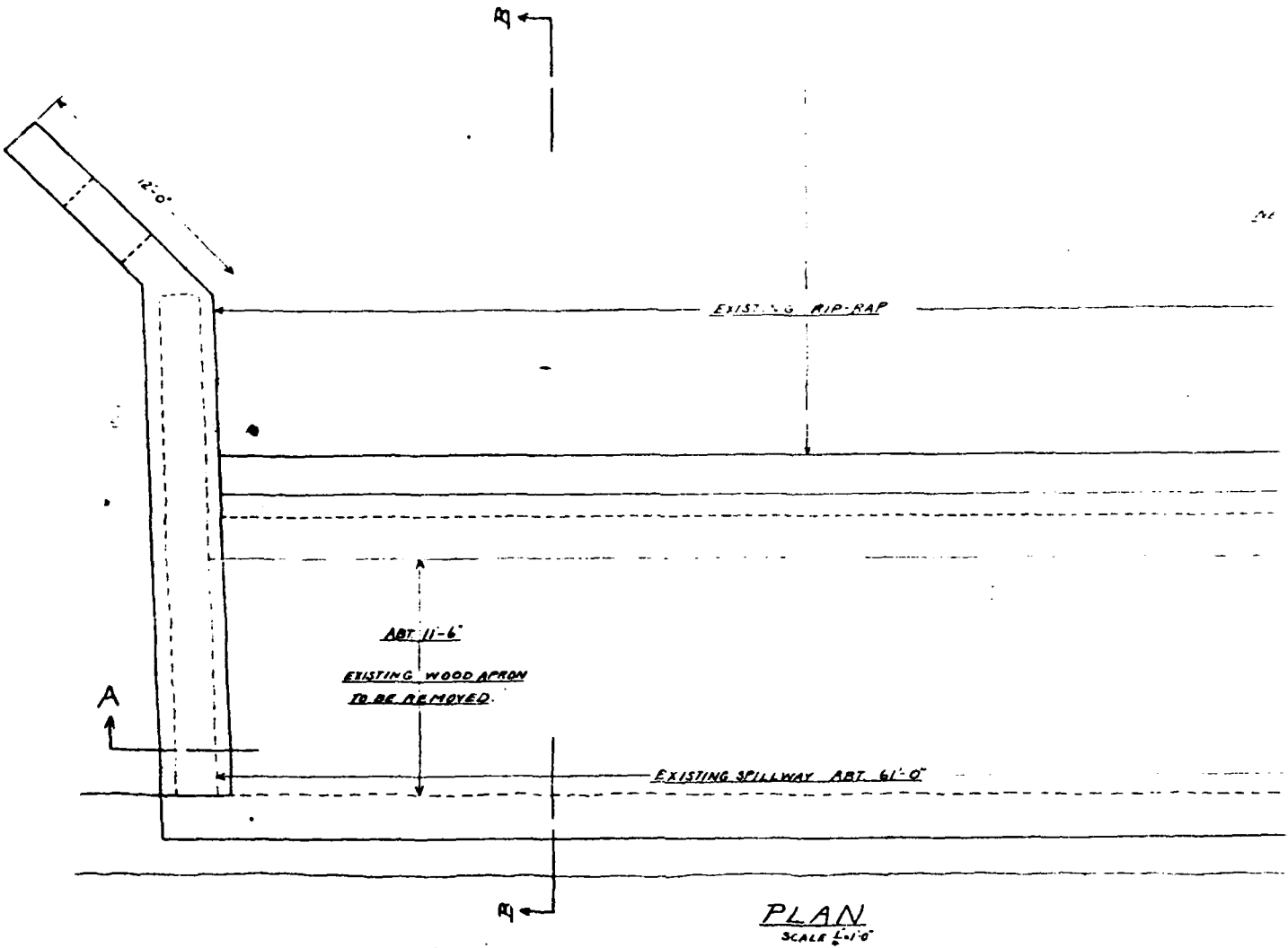
DESIGNED BY CHAS. T. MAIN, INC.
DRAWN BY NORTH CAROLINA

CLIENT 305
1697 7 51

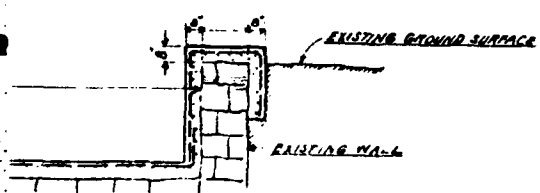
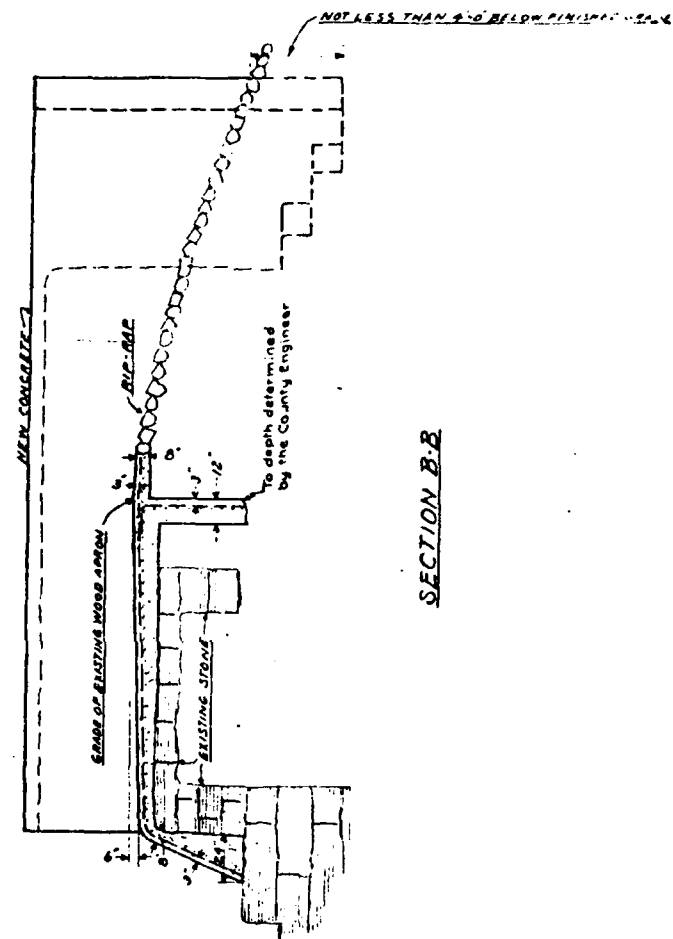
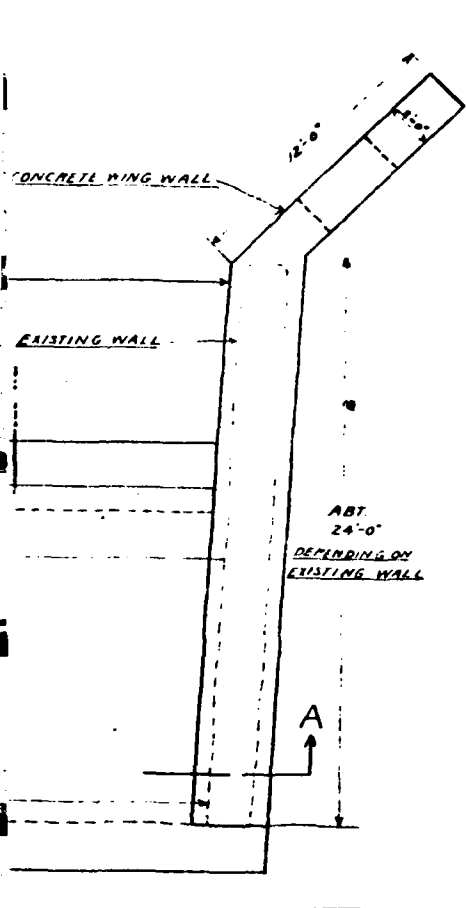
FIGURE B-2

DAM NO 10-34

HAZEL HYDRA



SECTION AA

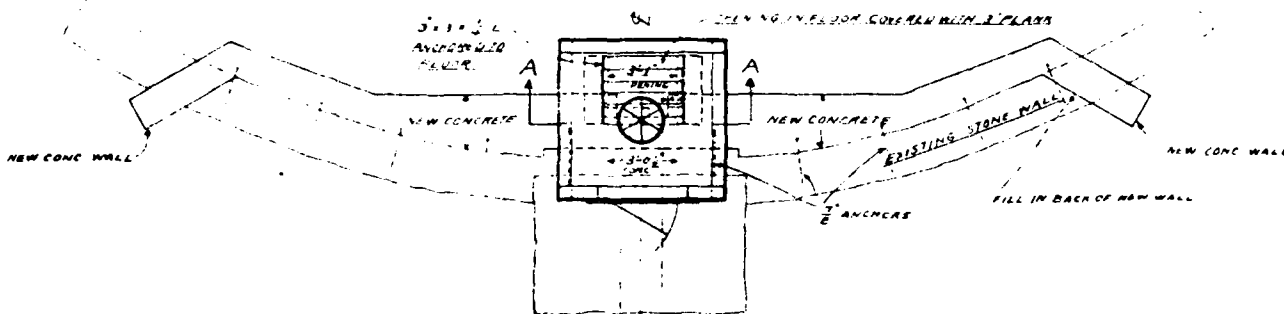


PLAN REDUCED APPROXIMATELY 50 %

| | |
|---|---|
| <p>WORCESTER COUNTY COMMISSIONERS WORCESTER COUNTY ENGINEERING DEPARTMENT PLAN OF PROPOSED ALTERATIONS TO SPILLWAY AT SOUTH CHARLTON RESERVOIR FOR AMERICAN WOOLEN COMPANY INC AS FILED AND APPROVED BY THE COUNTY COMMISSIONERS SCALES AS NOTED</p> | |
| <p>APPROVED July 2, 1943 <i>Elbert M. Connerly</i> CHAIRMAN</p> | <p>SUBMITTED July 1, 1943 <i>P. C. Hadden</i> COUNTY ENGINEER</p> |
| <p>DAM NO 10-34</p> | |

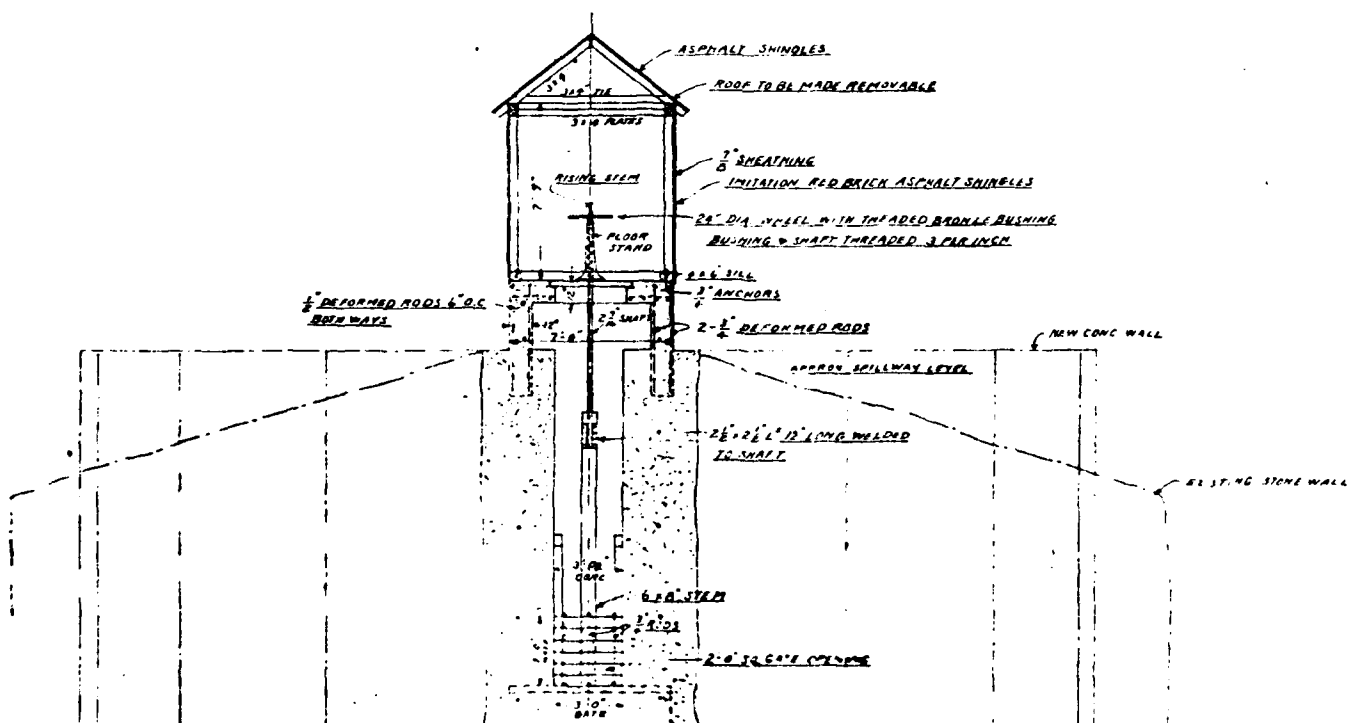
2

FIGURE B-3

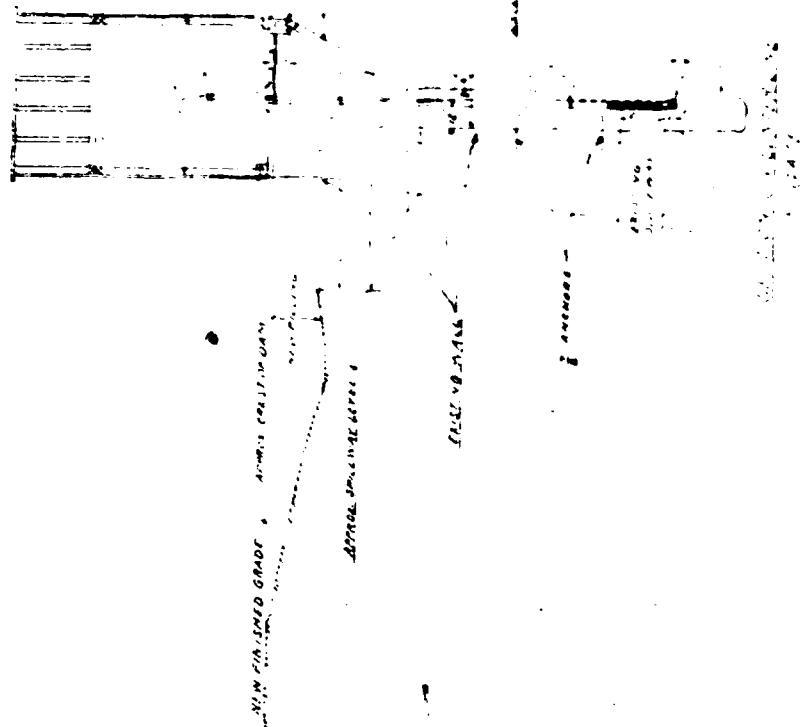


PLAN

SCALE 1/8" = 1'-0"



SECTION - A



PLAN REDUCED APPROXIMATELY 50 %

WORCESTER COUNTY COMMISSIONERS
 WORCESTER COUNTY ENGINEERING DEPARTMENT
 PLAN OF PROPOSED ALTERATIONS
 TO GATEWAY
 AT SOUTH CHARLTON RESERVOIR
 FOR AMERICAN WOOLEN COMPANY INC
 AS FILED AND APPROVED BY THE
COUNTY COMMISSIONERS
 SCALES AS NOTED

APPROVED: July 2, 1943

Edw. H. G. G. G.
 CHAIRMAN

George W. Jones

SUBMITTED: July 2, 1943

W. H. H.
 COUNTY ENGINEER

DAM NO 10-34

2

ENCLOSURE



LOOKING SO

DEGREE OF TOP OF

HORIZONTAL 554
VERTICAL 554

Embankment to be
To be eventually raise

| TOWN OR CITY | DECREE NO. | PLAN NO. | DAM NO. |
|---|---------------------------------|----------|---------|
| Charlton | | | 10-34 |
| <p>LOCATION: So Charlton Reservoir - 1960 - owned by the Town of Charlton, S.C. DOCKET NO. 100.</p> | | | |
| <p>DESCRIPTION OF DAM: Earth - Rubble - Stepped Stone Spillway</p> | | | |
| <p>DESCRIPTION OF RESERVOIR & WATERSHED: Potters Brook</p> | | | |
| Type | Length of Watershed | | |
| Length | Width | | |
| Height | Is Watershed Cultivated | | |
| Thickness top | Percent in Forests | | |
| bottom | Steepness of Slope | | |
| Downstream Slope | Kind of Soil | | |
| Upstream | No. of Acres in Watershed | | |
| Length of Spillway | Length of Reservoir | | |
| Size of Gates | Width | | |
| Location of Gates | Max Flow Cu. Ft. per Sec. | | |
| Flashboards used | Head or Flashboards - Low Water | | |
| Width Flashboards or Gates | High | | |
| Dam designed by | GENERAL REMARKS | | |
| " constructed by | Year constructed | | |
| <p>Owned by Stevens Linen Works and Dodge Felt Co.</p> | | | |
| <p>Inspected Jan. 3, 1925, L.O. Marden</p> | | | |
| <p>Inspected Feb. 8, 1928, L.O. M. & F.F.P. & Mr. Knight</p> | | | |
| <p>Engineer for S. Slater & Sons, Webster.</p> | | | |
| <p>Inspected: Nov. 7, 1928 - No work done pond drawn flat.</p> | | | |
| <p>Inspected: July 22, 1929 - L.O. Marden. Same condition.</p> | | | |
| <p>Inspected: Dec. 17, 1931, L.O. Marden</p> | | | |
| <p>" : Jan. 26, 1932 - L.O.M., Prof. Allen</p> | | | |
| <p>" : Nov. 4, 1934 - "</p> | | | |
| <p>1937 - Owned by Richard T. Waks</p> | | | |
| <p>Inspected: Jan. 27, 1932 LOM</p> | | | |
| <p>Inspected: Oct. 6, 1938 - B. P. St. John</p> | | | |
| <p>" April 3, 1940 - E.M. Crockett - L.O.M.</p> | | | |
| <p>Spofford. Lindquist - Sullivan - Wagner - Smith - Toomey.</p> | | | |
| <p>condition. 1938 Flood - 1.5 over crest</p> | | | |

PREVIOUS INSPECTIONS (PARTIAL LISTING)

COPY OF INSPECTION CARD ON FILE AT THE MASSACHUSETTS
DEPARTMENT OF PUBLIC WORKS, DISTRICT OFFICE, WORCESTER.

2-14-54-34

TOWN OF CHARLTON

CHARLTON, MASS. 01507



BOARD OF SELECTMEN

DEPARTMENT OF PUBLIC WORKS
DEPUTY CHIEF ENGINEER
WATERWAYS

RECEIVED MAY 5 1975

Referred To L. Andrus
Report Back to _____
File _____

May 1, 1975

Department of Public Works
Division of Waterways
100 Nashua Street
Boston, Mass. 02114

Attention: Mr. Malcolm Graf, Associate Commissioner

Gentlemen:

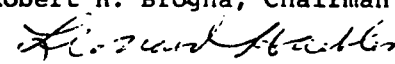
On April 27, 1975, Mr. Fred Murkland, Municipal Aide, attended and testified at a hearing on petitions for the reconstruction of Oxbow Bridge, Charlton, over Little River and repairs to the dam and spillway and reconstruction of the gate house and gates at the Charlton Reservoir Dam.

We would be interested to know if the Department of Public Works, Waterways Division could send a representative to view and make recommendations on the South Charlton Reservoir Dam which is an earthen dam.

We would appreciate any aid and assistance from your department in this matter as we do hold this as utmost important.

Very truly yours,


Robert H. Brogha, Chairman


Leonard Haebler


George C. McKinstry, Jr.

BHM:rb

B-7

GRANITE RESERVOIR DAM

May 6, 1975

Board of Selectmen
Town Hall
Charlton, Massachusetts 01507

RE: Inspection request-Dam #3-1A-34-34
Charlton
South Charlton Reservoir Dam

Gentlemen:

Reference is made to your letter dated May 1, 1975 wherein you request an inspection of the above dam.

An inspection by an engineer from the Massachusetts Department of Public Works is hereby requested. In the event that you, or your representative, wish to be present during the inspection please contact, Mr. Willis Regan, Massachusetts Department of Public Works District #3, Dams and Reservoir Engineer, 403 Belmont Street, Worcester, telephone 754-7204.

Upon the submittal of the inspection report you will be notified in writing by this office of our findings. If we may be of further assistance, please do not hesitate to contact us.

Very truly yours,

Norman L. Diegoli
NORMAN L. DIEGOLI, P.E.
Acting Deputy Chief Engineer

J. J. Lyons
LRA:jmp
cc: J. J. Lyons
W. Regan

May 28, 1975

Board of Selectmen
Town Hall
Charlton, Massachusetts 01507

RE: Inspection-Dam #3-14-54-34
Charlton
South Charlton Reservoir Dam
(Granite Reservoir)

Gentlemen:

On May 12, 1975, an engineer from the Massachusetts Department of Public Works made a visual inspection of the above dam. Our records indicate that the Town of Charlton is the owner. Will you please notify this office if this information is not current.

The inspection was made in accordance with Chapter 253 of the Massachusetts General Laws, as amended by Chapter 595 of the Acts of 1970 (Dams-Safety Act).

The results of the inspection indicate that repairs and/or maintenance is needed. The following conditions were noted that require attention:

1. The upstream embankment of the dam shows evidence of erosion apparently caused by wave action. Some slope protection such as riprap should be provided to eliminate this problem.
2. There appears to be seepage through the embankment as evidenced by pools of standing water at the downstream toe of the embankment. This condition should be investigated and then followed by the necessary corrective action.
3. There is evidence of deteriorating concrete at:
 - a. The low concrete walls adjacent to the gate house
 - b. The gate block inside the gate house
 - c. The junction of the easterly training wall and the spillway floor (minor).

These areas should be repaired as needed.

4. Remove the growth of brush and trees from the embankment of the dam.

Inspection-Dams
Charlton
South Charlton Reservoir Dam

-2-

May 28, 1975

5. There is some bulging of the downstream wall easterly of the discharge opening (minor) and most noticeable in line with the opening. While this does not appear serious at this time it may be that a line of seepage adjacent to the stone box and through the dam may exist and could create a major problem. Settlement of the top of the embankment and upstream erosion all within this area require investigation and corrective repairs.
6. The gate could not be fully closed. The constriction should be removed.
7. There is surface erosion along the top of the dam at the southwesterly corner of the gate house and behind the westerly training wall. These areas should be filled with suitable material, properly compacted and graded.

It is recommended that you obtain the services of a Registered Professional Civil Engineer experienced in the design, maintenance and construction of dams who can best advise you what course of action to take. If major repairs or alterations to the dam are contemplated then the enclosed Department application form must be completed and returned to this office for review and approval before construction may begin.

We call these conditions to your attention now and expect your attention to these matters. If we may be of assistance, please do not hesitate to contact us. With any correspondence, please include the number of the dam as indicated above.

Very truly yours,

Norman L. Dierckli
NORMAN L. DIERCKLI, P.E.
Acting Deputy Chief Engineer

LEA:jap
LEA:jap
Enc.

cc: J. J. Lyons
W. Regan

Reproduced from
best available copy.

DESCRIPTION OF DAM

DISTRICT 3

Submitted by W. REGAN

Dam No. 3-14-54-34

Date MAY 14, 1975

City/Town CHARLTON

Name of Dam So. CHARLTON Reservoir
(referred to as GRANITE Reservoir on Top)

1. Location: Topo Sheet No. 21C

Provide 8 1/2" x 11" in clear copy of topo map with location of Dam clearly indicated.
N/A. Prior To

2. Year built: 1925 Year/s of subsequent repairs CIRCA 1955

3. Purpose of Dam: Water Supply _____ Recreational _____
Irrigation _____ Other Formerly A Mill Dam - IS N
NOW A MUNICIPAL WATER SUPPLY

4. Drainage Area: 8.11 sq. mi. _____ acres

5. Normal Ponding Area: 240± acres; Ave. depth _____

Impoundment: N/A gals.; _____ acre ft.

6. No. and type of dwellings located adjacent to pond or reservoir

125± *Perm. & Summer Homes - Perm Dwellings Predominate*
i.e. summer homes, etc.

7. Dimensions of Dam: Length 640'± Max. Height 20'±

Slopes: Upstream Face Approx. 1 1/2:1

Downstream Face Vertical

Width across top 50'± max, 25' Width most typical (See Sketch A)

8. Classification of Dam by Material:

Earth ✓ Conc. Masonry ✓ Stone Masonry ✓

Timber _____ Rockfill _____ Other RIP RAP U.S. FSD

9. A. Description of present land usage downstream of dam:

100 % rural; SUBURBAN % urban.

B. Is there a storage area or flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure? yes _____ no ✓

10. Risk to life and property in event of complete failure.

See Note
below

No. of people _____
 No. of homes _____
 No. of Businesses _____
 No. of industries _____ Type _____
 No. of utilities _____ Type _____
 Railroads _____
 Other dams _____
 Other _____

11. Attach Sketch of dam to this form showing section and plan on 8 1/2" x 11" sheet.

12. How to Locate: W.B. ON Rte 20, TURN LT. onto RICHARDSON Rd 0.8± miles beyond OXFORD TOWN LINE. TRAVEL 1.6± miles TO PARTRIDGE Hill Rd. TRAVEL 1.8± miles down Rd, DAM IS Rt OF Rd (1/4± mile beyond Goburn Rd. Partridge hill Rd. Int.)

Note (10): This dams Failure discharge would WASH out three Rd. Crossings (& their Associated Utilities), & IS a Threat to life & Property @ 5± residences. The County originally gave this dam a high HAZARD rating, but this is now mitigated by the fact that the discharge flows into the Army Corps of Eng. BUFFUMVILLE dam which has large Storage Capacity. This Storage Capacity, however, could be reduced if the situation at Dam No. 3-14-226-13 (Gardow Chemical Co. dam - 3/24/75 inspection) is not Satisfactorily Resolved.

INSPECTION REPORT - DAMS AND RESERVOIRS

1. Location: City/Town CHARLTON Dam No. 3-14-54-34

Name of Dam South Charlton Reservoir Inspected by W. REGAN

Date of Inspection MAY 12, 1975

2. Owner/s: per: Assessors _____ Prev. Inspection _____

Reg. of Deeds _____ Pers. Contact ☒

1. Board of Selectmen, Town Hall, CHARLTON, MASS. ^{ZIP} 01507
Name _____ St. & No. _____ City/Town State Tel. No. _____

2. _____
Name _____ St. & No. _____ City/Town State Tel. No. _____

3. _____
Name _____ St. & No. _____ City/Town State Tel. No. _____

3. Caretaker (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Name: _____ St. & No.: _____
City/Town: _____ State: _____ Tel. No.: _____

4. No. of Pictures taken _____

5. Degree of Hazard: (if dam should fail completely)*

1. Minor _____ 2. Moderate ☒
3. Severe _____ 4. Disastrous _____

* This rating may change as land use changes (future development)

6. Outlet Control: Automatic _____ Manual ☒
Operative ☒ yes; _____ No.

Comments: Gate is operative to a degree - CANNOT be fully closed - 3'x3' GATE PASSAGE Flowing 1" Full with Gated Closed AS MUCH AS POSSIBLE

7. Upstream Face of Dam: Condition:

1. Good _____ 2. Minor Repairs ☒
3. Major Repairs _____ 4. Urgent Repairs _____

Comments: Remove Trees & brush, Augment Slope Protection, Repair Surface Erosion [More Specifics IN (12) Remarks & Recommendations]

8. Downstream Face of Dam:

Condition: 1. Good _____ 2. Minor Repairs ☒ _____
 3. Major Repairs ☒ _____ 4. Urgent Repairs _____

Comments: *Remove Trees & Brush adjacent to D.S. Face
 Some Seepage Pools beyond d.s. Face. Minor to
 Moderate Convexity of d.s. WALL*

9. Emergency Spillway:

Condition: 1. Good _____ 2. Minor Repairs ☒ _____
 3. Major Repairs _____ 4. Urgent Repairs _____

Comments: *SPALLING OF Toe OF CHECKWALL (East Side) @
 Junction with Spillway Floor*

10. Water Level at time of inspection: $\frac{1}{2} \pm$ ft. above ☒ below _____
 top of dam _____ principal spillway Crest
 other _____

11. Summary of Deficiencies Noted:

Growth (Trees and Brush) on Embankment ☒ _____
 Animal Burrows and Washouts ☒ _____
 Damage to slopes or top of dam ☒ _____
 Cracked or Damaged Masonry ☒ _____
 Evidence of Seepage ☒ _____
 Evidence of Piping _____
 Erosion ☒ _____
 Leaks _____
 Trash and/or debris impeding flow _____
 Clogged or blocked spillway _____
 Other GATE CAN be Closed only Partially - Timber Gate
Stem in poor Cond. Repair made by bolting
1/4" Steel Plate to Same - Gate block
Concrete is deteriorated

12. Remarks & Recommendations: (Fully Explain)

The Following are Specific descriptions of deficiencies noted during The Inspection:

① deterioration of the upstream Slope due to wave Action is in Evidence at the following locations:

a) AT The low Concrete WALL extending Easterly & westerly From The Gate house

b) The 120' Section of the U.S. Face (Tangent to The Western TRAINING WALL of The Spillway) extending 120' in The westerly direction.

② Downstream Pools of Standing water indicating Seepage Through The embankment:

a) Tangent to The downstream Toe of WALL 125' West of The East End of The dam

b) 20' beyond The ^{ds.} Toe of Slope, 120' West of The Spillway

c) 20' beyond d.s. WALL West of The Spillway

③ deterioration of Concrete:

a) at The low Concrete WALLS (Elev = W.S. - 4" to W.S. + 6") adjacent to The Gate house, both E. & W. Sides.

b) At The Conc Gate block - inside The Sub Gate house adjacent to Gate Apparatus

c) at The Junction of The East Check wall and Spillway Floor (Spalling - Moderate)

(Cont in 3A)

13. Overall Conditions

1. Safe _____
2. Minor repairs needed ✓ _____
3. Conditionally safe - major repairs needed ✓ _____
4. Unsafe _____
5. Reservoir impoundment no longer exists (explain)
Recommend removal from inspection list _____

(3A)

④ TREES & BRUSH

- (a) Remove Trees & Brush from Top & both Faces of Embankment West of Spillway
- (b) Remove Trees adjacent to d.s. WALL adjacent to the East Side of the Spillway and Near the ~~downstream~~ d.s. toe @ the discharge End of the Gate Passage
- (c) Remove large Pile of dead Trees & brush adjacent to d.s. WALL W. of the Spillway

⑤ Convexity of d.s. WALL

- (a) MINOR Convexity was Noted @ Various locations ~~at the~~ E. of the Gate discharge opening.
- (b) Pronounced Convexity was Noted at the Portion of the d.s. WALL ~~at~~ over the Gate discharge opening.

Note: (5) The Wall doesn't appear in imminent danger of Collapse but this ~~is~~ apparently is a progressive condition of long duration & should be closely observed for signs of ^{Further} Progression.

⑥ Partial Gate Inoperability:

- a) The Gate can be only Partially Closed but they can be Closed to the extent that a 1" Flow emerges from the discharge end of the 3' x 3' Gate Passage. What little of the Gate apparatus that was Accessable to Visual Inspection was in Fair to Poor Condition. Gate repair or reconstruction is ^{very} desirable but not urgent. If the 3' x 3' passage was discharging fully (even ^{considering} under the 20± head), the 10½' x 5' Box Culv. just d.s. on Partizidge Hill Rd could probably handle it.

(Cont. on Sheet 3B)

(3B)

⑦ Depression on Top of Dam:

(a) There is one 16'± x 2'± x 1'± deep depression on the top of the Embankment 25'± West of the Gate House & Close to the Top of the downstream Wall

⑧ Surface Erosion (Top of Embankment)

(a) (a) The S.W. Corner of the Gate House

(b) Adjacent to the back of the Western Training Wall

General: These individual evidences of deterioration are not very severe, but taken in total they add up to a major amount of work. The Town apparently plans to spend some money on Restoration (As per the Highway Supt.) and they have been (within the last year or so) in contact with the R.H. White Const. Co. who made a promise to send a diver down to inspect the lower gate structure (at some unspecified date). The Town further plans to replace the Timber Gate Shed with a Conc. Block Shed because of past Vandalism.

The Town should be encouraged to remedy the foregoing deficiencies & should be further informed as to the advisability of going through the Permit process if the proposed repairs are major enough to warrant the same.

50. CHARLTON RESERVOIR

(referred To As Granite Reservoir on Topo.-U.S.G.S.)

Further Protection (non-RIP RNP
of U.S. Slope Required)

Eroded +

Concrete Gran. Slabs

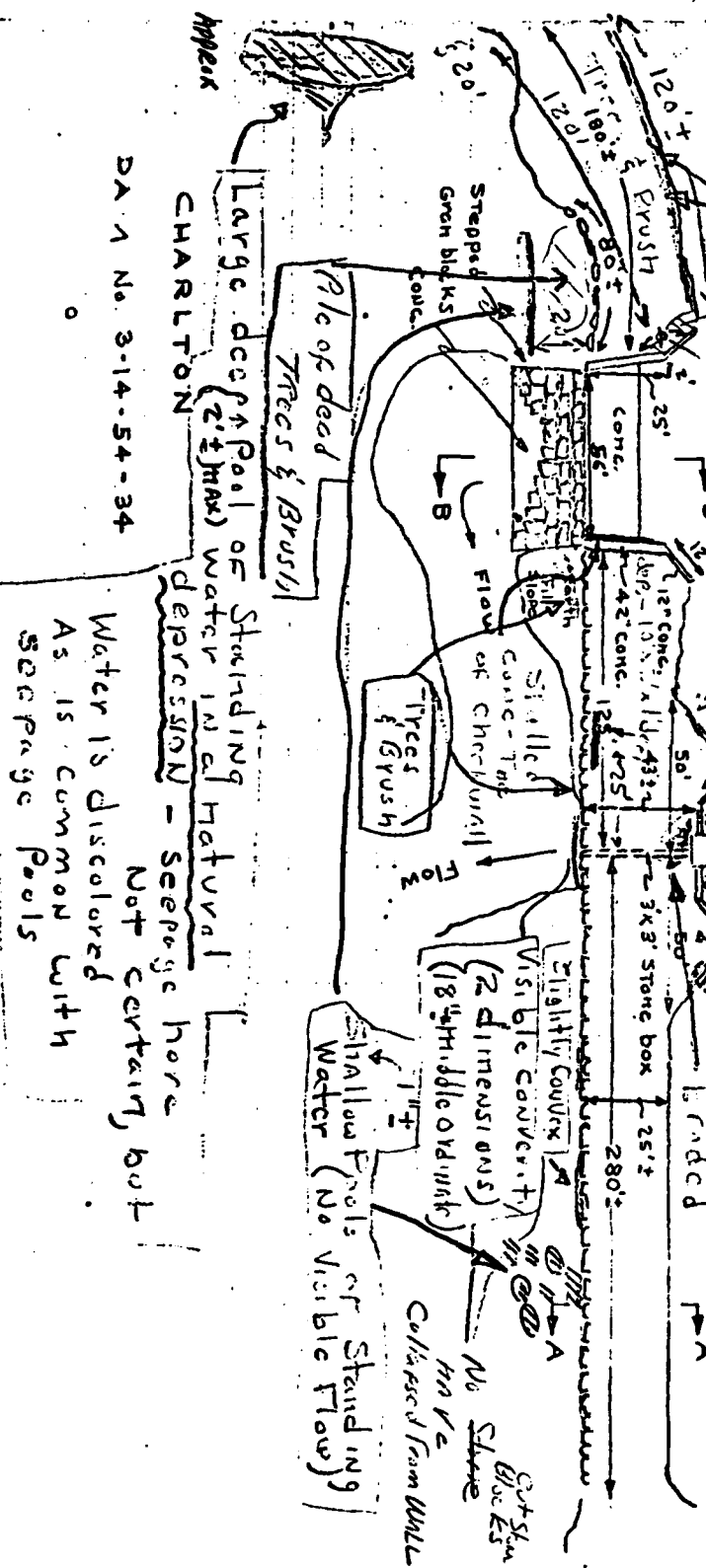
Timber Gate Shed on
conc. Galt block (7'x8')

(one gate)-Partial { operable ...

decayed timber item

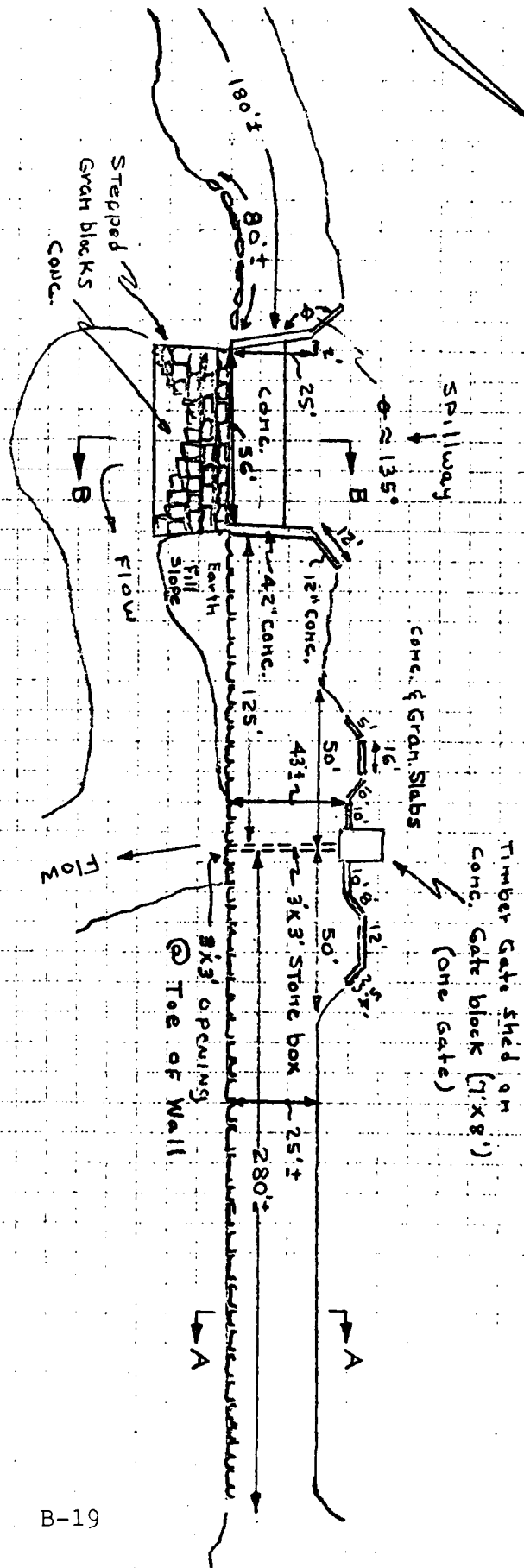
GRANITE RESERVOIR DAM

B-18



SO. CHARLTON RESERVOIR

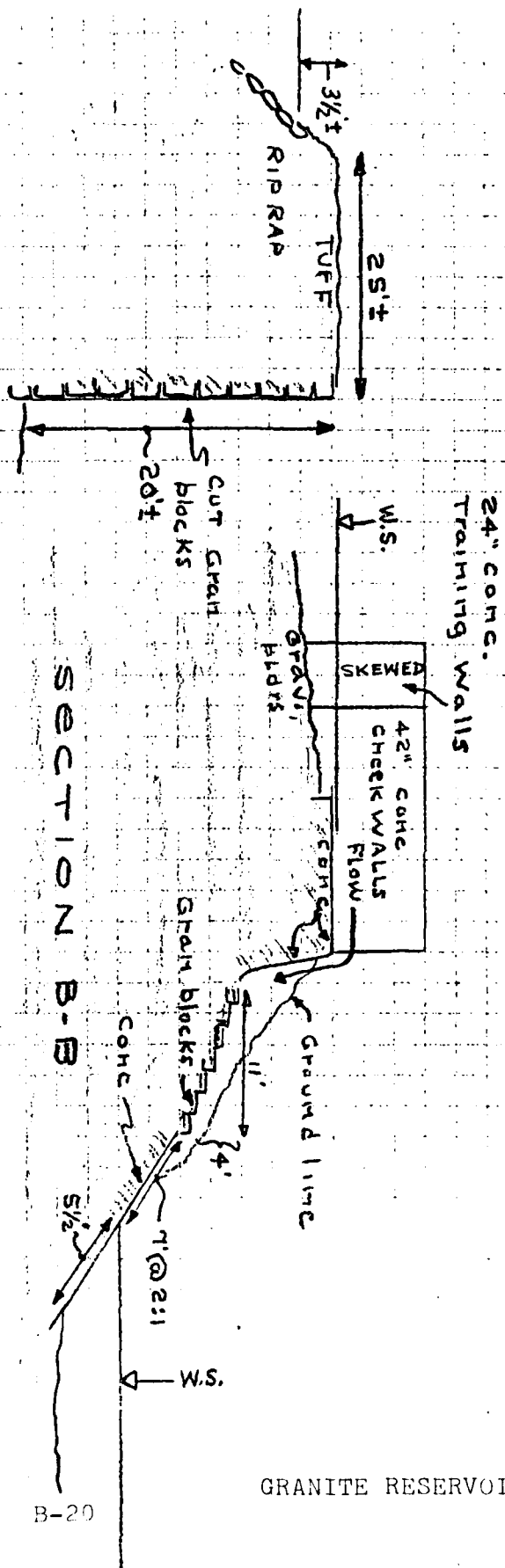
(referred to as Granite Reservoir on Topo.-U.S.G.S.)



CHARLTON

DAM No. 3-14-54-34

SECTION
A-A



CHARLTON

DAM No. 3.14-54-34

GRANITE RESERVOIR DAM

INSPECTION REPORT & DATA FOR DAMS

Owner: Town of Charlton
 His Address: Board of Selectmen
 Function of Dam: Reservoir

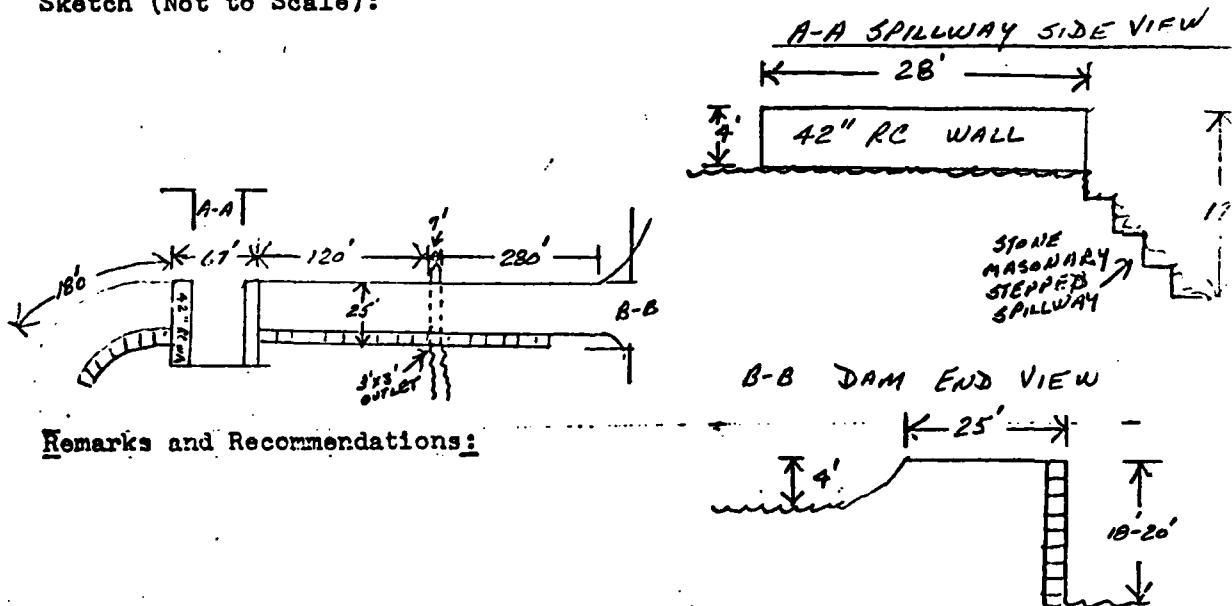
Location & Access: West of Partridge Hill Rd.
0.32 Mile North of Lelandville Rd. Intersection
 USGS Quad. Webster Lat. 42°06'30" Long. 71°55'45"
 Drain. Ar. 2.11 Sq. Mi. Ponds: ac.; Res. @ dam: 2450
 Character of D.A.:

Dam No. 54-34
 Town: Charlton
 Stream: Little River (Granite Res.)
 Pond: S. Charlton Reservoir
 Date: 2/22/77
 By: R. J. [illegible]
 CONDITION RATING
 Structural: GOOD
 Hydraulic: 60' x 4'
 General: GOOD
 PRIORITY: NONE

Estimated
 Discharge:
 Capacity:

General Description of Dam and Discharge Control:
STONE MASONRY FRONT FACE EARTHEN DAM W/-
3'x3' GATE 300' E WEST OF EAST END OF DAM, NO SLOTS FOR
FLASHBOARDS

Sketch (Not to Scale):



Remarks and Recommendations:

Date
2/22/77

By
[Signature]
R. J. [illegible]

Comment

Dam No. 3-14-54-34

TOWN Charlton DAM NO. 10-34 S. Charlton Rd
LOCATION _____ STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by _____ Place _____ Use _____
Inspected by B. Reynolds Date 9 Sept. 1969
Type of Dam _____ Condition _____

SPILLWAY

Flashboards in Place None Recent Repairs _____
Condition Good - level 4" over crest
Repairs Needed _____

EMBANKMENT

Recent Repairs _____
Condition _____
Repairs Needed _____

GATES

Recent Repairs Check
Condition _____
Repairs Needed _____

LEAKS

How Serious _____

DATE: 9 Sept 1969 B. Reynolds

County Engineer

TOWN Charlton DAM NO. 10-34 St. Charlton

LOCATION _____ STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by _____ Place _____ Use _____

Inspected by _____ Date _____

Type of Dam _____ Condition _____

SPILLWAY

Flashboards in Place None Recent Repairs _____

Condition Intact

Repairs Needed None

EMBANKMENT

Recent Repairs _____

Condition _____

Repairs Needed _____

GATES

Recent Repairs _____

Condition _____

Repairs Needed _____

LEAKS

How Serious _____

DATE: 3/20/69

County Engineer

TOWN CHARLTON DAM NO. 10-34
LOCATION So. Charlton Res. STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by _____ Place _____ Use _____
Inspected by W. J. [unclear] Date 5 MAR 69
Type of Dam _____ Condition _____

SPILLWAY

Flashboards in Place _____ Recent Repairs _____
Condition clear, water running over spillway, apt.
Repairs Needed on spillway about 150 ft.

EMBANKMENT

Recent Repairs _____
Condition _____
Repairs Needed _____

GATES

Recent Repairs _____
Condition closed, some leakage on outlet side
Repairs Needed _____

LEAKS

How Serious _____

DATE: _____ B-24 _____ GRANITE RESERVOIR DAM

TOWN Charlton DAM NO. 10-34 So. Charlton IC

LOCATION _____ STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by _____ Place _____ Use _____

Inspected by _____ Date _____

Type of Dam _____ Condition _____

SPILLWAY

Flashboards in Place None Recent Repairs _____

Condition Water level is off in new top

Repairs Needed replace with new

EMBANKMENT

Recent Repairs _____

Condition _____

Repairs Needed _____

GATES

Recent Repairs _____

Condition _____

Repairs Needed _____

LEAKS

How Serious _____

DATE: 2/21/09

County Engineer

TOWN Charlton DAM NO. 10-34
LOCATION Partridge Hill Rd STREAM South Fork - Little River

"South Charlton Reservoir."
WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by Town of Charlton Place Selectmen Use Storage Pond
Inspected by D. B. Reynolds Date 3-19-68 2:25 PM
Type of Dam Earth - Stone - Concrete Condition Good

SPILLWAY

Flashboards in Place _____ Recent Repairs _____
Condition The water level is 2' below the top of the concrete wall.
Repairs Needed _____

EMBANKMENT

Recent Repairs _____
Condition _____
Repairs Needed _____

GATES

Recent Repairs Gate House is in good condition. Gate may be
Condition partly open but is blocked by ice at outlet.
Repairs Needed _____

LEAKS

How Serious _____

DATE: _____ County Engineer _____

TOWN Charlton

DAM NO. 10-34

LOCATION Wye side at Partridge Rd

STREAM South Fork - Little River

"South Charlton Reservoir"

WORCESTER COUNTY ENGINEERING DEPARTMENT

WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by Town of Charlton Place Charlton Use Pond

Inspected by W.C. - W.C. Date Oct. 19, 1967

Type of Dam Earth and stone dam Condition Good condition

SPILLWAY

Flashboards in Place no boards Recent Repairs

Condition Good condition. Additional spillway area

Repairs Needed was to be provided by State and Town.

Town has appropriated \$12,000 for this project.

EMBANKMENT

Recent Repairs

Condition Good condition

Repairs Needed Trees and brush should be removed.

GATES

Recent Repairs

Conditions Gate is open. Gate is partly open on this side.

Repairs Needed Gate House is wide open. Locks should be

provided on house and wheel.

LEAKS

How Serious Seepage is visible between dam and abutment.

DATE:

County Engineer

TOWN Charlton DAM NO. 10-34
LOCATION Wyside of Partridge Rd. STREAM South Fork - Little River

"South Charlton Reservoir."

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by Town of Charlton Place Selectmen Use Storage
Inspected by JOT-WOL-GUC Date Sept 20, 1967
Type of Dam Earth and Stone Dam Condition Fair

SPILLWAY

Flashboards in Place No boards Recent Repairs _____

Condition Good condition - repaired in 1955

Repairs Needed Additional spillway area was to be provided by Town and
MDPW @ 50% each. * 1955 was voted by Town but matching money by Gen.
of Mass. has never been voted by Legislature.

EMBANKMENT

Recent Repairs _____

Condition Good condition except for trees and brush which should

Repairs Needed be removed from entire structure.

GATES

Recent Repairs _____

Condition Good condition Gate is about 1/4 open on this date

Repairs Needed Gate and Gate House should be provided with
suitable locks.

LEAKS

How Serious Small seepage visible below embankment

DATE: _____ County Engineer

TOWN Charlton DAM NO. 10-34
LOCATION Lelandville Rd STREAM South Fork - Little River.

"South Charlton Reservoir."

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by Town of Charlton Place Selectmen Use Storage Reservoir
Inspected by J.O.T. - W.O.L. Date June 2, 1966
Type of Dam Earth-Stone-Concrete Condition Good to Fair

SPILLWAY

Flashboards in Place No boards Recent Repairs Repairs in 1956
Condition Good condition. Stepped stone downstream apron is good. Concrete
Repairs Needed crest and abutment walls are good. (Proposed new additional
overflow spillway has not been constructed to-date.)

EMBANKMENT

Recent Repairs Vertical downstream wall has a large bulge near gate
Condition outlet - it is in same condition as previous inspections
Repairs Needed House has been constructed below embankment near
ely end of dam. Embankment is covered with trees and brush.

GATES

Recent Repairs _____
Condition Gate House is wide open - no lock on door. No lock on gate
Repairs Needed Small leak is visible at pipe outlet.

LEAKS

How Serious Seepage is visible at toe of downstream wall - near Ely
end of dam. Same condition as previous inspections.

DATE: _____ County Engineer

TOWN Charlton DAM NO. 10-34

LOCATION 200' Wly of Partridge Hill Rd. STREAM S. Fork - Little River

"South Charlton Reservoir."

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by Town of Charlton Place Selectmen Use Storage Reservoir.

Inspected by FEP - WOL Date May 15, 1964

Type of Dam Earth-Stone-Concrete Condition Good to fair.

SPILLWAY

Flashboards in Place No boards Recent Repairs _____

Condition Good condition. 1' of water over crest. Additional spillway

Repairs Needed area should be provided - money has been appropriated
by the Town of Charlton - matching sum to be provided by the State of Mass.

EMBANKMENT

Recent Repairs Trees and brush should be removed

Condition Down stream wall is bulged in two places - bulge

Repairs Needed near gate outlet is about 1.5' out of line

This condition has been the same for many years.

GATES

Recent Repairs _____

Condition Good - Gate House is unlocked.

Repairs Needed _____

LEAKS

How Serious Small seepage is visible below wall.

DATE: _____ County Engineer _____

Commonwealth of Massachusetts

10-34

Worcester, a.s.

At a meeting of the County Commissioners of the County of Worcester, begun and holden at Worcester, within and for said County, on the First Thursday of September, A.D. 1956, being the 6th day of September A.D. 1956, at which meeting were present

Joseph A. Aspero
Francis E. Cassidy
Edward P. Bird
WORCESTER COUNTY COMMISSIONERS

The following ORDER is issued to Textron, Inc., 50 South Main Street, Providence 1, Rhode Island, Mr. Lawrence C. Plowman, Vice President.

The County Commissioners of the County of Worcester in pursuance of the statutes of the Commonwealth of Massachusetts have caused a thorough examination to be made of the dam situated at South Charlton Reservoir, in South Charlton, Massachusetts, a part of the town of Charlton, Massachusetts, and being owned by said Textron, Inc.

Said examination having been made by a competent Engineer, Leslie O. Marden, County Engineer of Worcester County,

Upon such examination, we find in our judgment the structure of the dam is not sufficiently strong to resist a recurrence of the flood of August 19, 1955 as the present spillway is of insufficient size to handle a flood of this magnitude,

We hereby determine that alterations are required to make the structure permanent and secure by Textron, Inc., as follows:

New Storm Spillway. A new storm spillway shall be constructed at the south end of the embankment of the dam in natural ground. The spillway shall be at least 30 feet in length, and have the elevation of the top of the abutments equal to the elevation of the abutment of the present spillway. The new crest shall be the same height as the present crest.

The crest of the spillway shall be composed of a concrete wall two feet thick constructed into hardpan, or solid material at an elevation picked by said Engineer, and having two abutment

walls of the same thickness constructed into the natural ground at each end of the spillway at least ten feet in length. The top of the aforesaid walls being equal to the top of aforesaid abutments of the present spillway. The walls shall be reinforced with 5/8" round deformed rods 12 inches on centers horizontally and vertically, and placed on both faces and into said abutment walls.

1. The excavation each side of said crest and walls shall be backfilled with clay or hard pan material agreed upon by the Engineers.

2. A channel from said spillway crest shall be excavated at a minimum grade agreed upon by the Engineers to a point in the present channel. $1\frac{1}{2}$ to 1 slopes shall be constructed on each side of the channel.

3. A gravel bed at least twelve inches in thickness shall be laid in the channel, and riprap at least fifteen inches thick shall be placed on the gravel bed and to a height on the $1\frac{1}{2}$:1 slopes of said channel to be determined by the Engineer.

4. a. Gate Section. Material from the dam embankment is carried in suspension in the water flowing in the stone gate passage, when the gate is open.

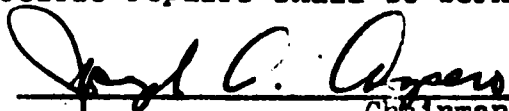
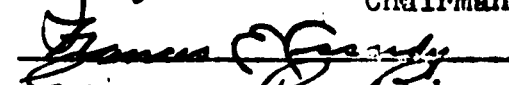

b. Investigation shall be made as to why this water is carrying material. The plans shall show a design for eliminating this flow of solids.

c. Brush and small trees shall be cut from the top of the embankment, roots grubbed out and the embankment top to be re-laid for a uniform height with the same elevation as the top of the spillway abutments.

5. The said Textron Inc., shall cause the alterations and repairs hereinafter set forth to be incorporated in plans and specifications by a competent Engineer and submitted for the approval of the County Commissioners.

6. Water shall be kept at a level of five feet below the crest of the spillway until the above reconstruction has been completed and approved by the County Commissioners.

7. The cost of the above specific repairs shall be borne by the owner.


Chairman


WORCESTER COUNTY COMMISSIONERS

APPENDIX C
PHOTOGRAPHS

GRANITE RESERVOIR DAM



NO. 1 UPSTREAM VIEW OF DAM



NO. 2 CREST OF RIGHT EMBANKMENT



NO. 3 DOWNSTREAM FACE OF DAM NEAR RIGHT ABUTMENT



**NO. 4 DOWNSTREAM FACE OF DAM ALONG
SPILLWAY DISCHARGE CHANNEL**

GRANITE RESERVOIR DAM



NO. 5 DOWNSTREAM FACE OF DAM IN AREA OF BULGE



NO. 6 SPILLWAY CASCADE AND STILLING POOL

GRANITE RESERVOIR DAM



NO. 7 DOWNSTREAM VIEW OF SPILLWAY



NO. 8 OUTLET WORKS ON UPSTREAM FACE OF DAM

GRANITE RESERVOIR DAM



NO. 9 OUTLET IN DOWNSTREAM WALL



NO. 10 DOWNSTREAM CHANNEL

GRANITE RESERVOIR DAM

APPENDIX D
HYDROLOGIC AND HYDRAULIC
COMPUTATIONS

| | <u>Page</u> |
|---|-------------|
| Figure D-1 Drainage Area - Granite Reservoir Dam | D-1 |
| Hydrologic and Hydraulic Computations | D-2 |

GRANITE RESERVOIR DAM

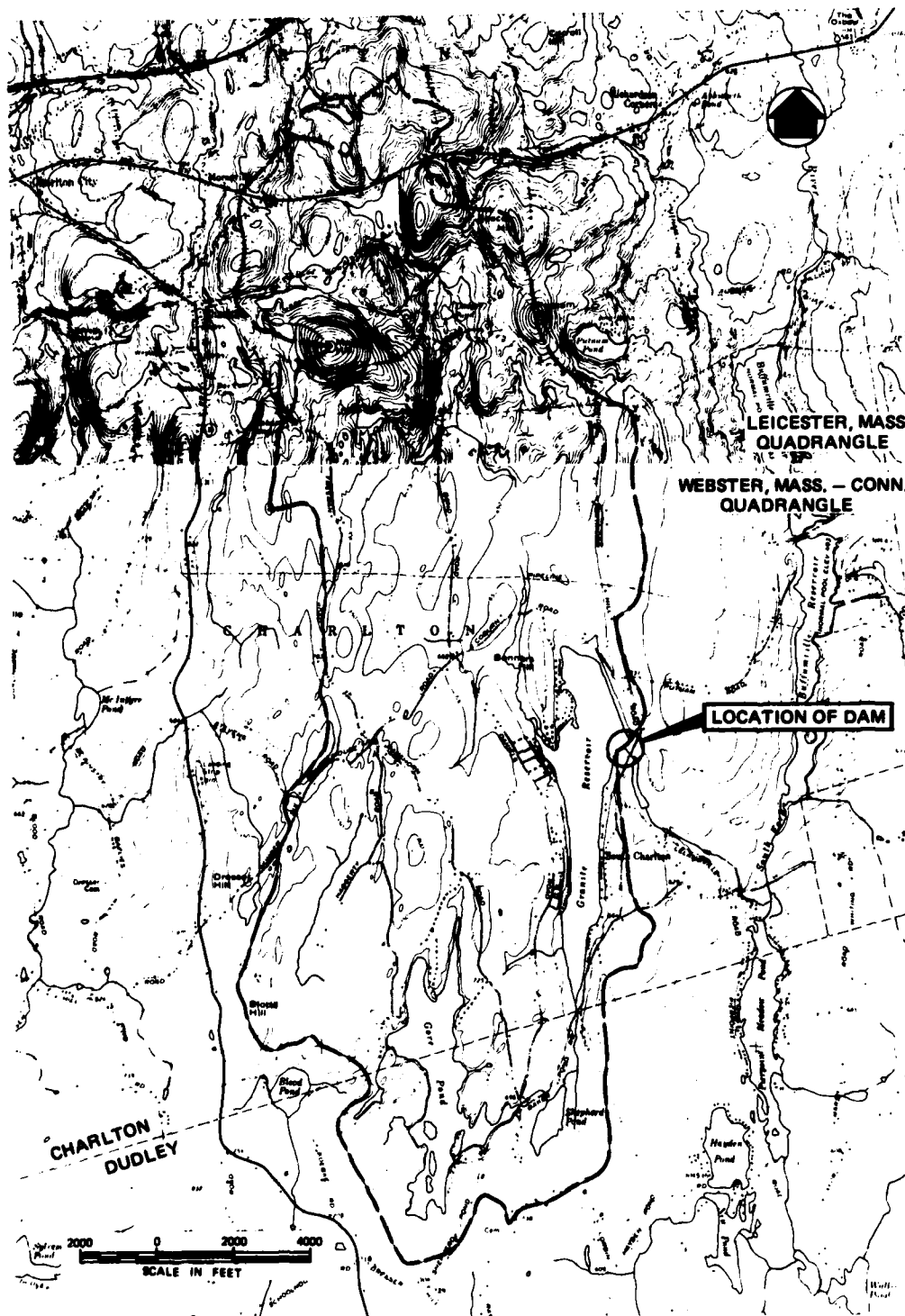


FIG. D-1 DRAINAGE AREA - GRANITE RESERVOIR DAM

Project Nat. Review of Non Fed. Dams Acct. No. 6191 Page 1 of 4
 Subject Worcester County, Mass. Comptd. By LEB Date 12/11/78
 Detail GRANITE (So. Charlton) RES. Ch'd. By 24BG Date 12/29/78

I Test Flood, Storage & Storage Functions

1- Total Drainage Area - 7.82 mi²

2- Pond(s) Area: .32 + .28 + .09 + .02 = 0.65 mi²
 Swamp(s) Area: 0.19 + .02 + .07 + .15 + .18 + .14 = 0.75
Total Area Ponds & Swamp(s): 1.40 mi²

$$\% \text{ Ponds \& Swamps} = \frac{1.40}{7.82} = 18\%$$

$$3- \frac{895 - 631}{14200} = 1.96$$

} Say Ave Slope = 2%

4- Using C. of E. Curves for Peak Flow Rates & above guide values the Peak Flow Rate was estimated to be closer to Flat FC than to "Rolling" and taken at 950 c.f.s./mi²
 Size Class: Interm. ; Hazard Pot.: Sign. ; Spill. Des. Flood: $\frac{1}{2}$ PMF to full PMF
 Use: Test Flood = $\frac{1}{2}$ PMF

$$5- \text{Test Flood Inflow} = \frac{1}{2}(950) 7.82 = 3700 \text{ c.f.s.}$$

6- Pond Storage

The pond area is .323 sq. mi. at elev. 631.
 Based on a const. area, storage increases at 207 ac. feet per foot of depth increase.

7- Storage Functions are based on $Q_{out} = Q_{in} \left[1 - \frac{S_{out}}{R} \right]$

S_{out} = Storage Vol. in Reservoir related to final Q_{out} in terms of inches of rain over the drainage area.

$$S(\text{in Inches}) = 12 D \left(\frac{.323}{7.82} \right) = 0.50 D ; R = \text{shr rain dist'n}$$

D = Storage Depth (above spillway) on reservoir, in feet

8- Storage Functions: (F_T) ; $D = 0$ @ Pond El. 631

$$F_T = 3700 - 389 S = 3700 - 193 D$$

II Discharge Ratings

A - Spillway

Width - 56', Crest - wide but rounded. - No Flashboards used
 [Ref.: Williams & Hazen "Hydr. Tables"]

Use Type M Weir & Multiplier = 0.90, $p = 20'$
 Weir Crest @ El. 631

| | | | | | | | |
|--------------------------------|--------|------|------|--------|--------|--------|--------------|
| Pond El. | = 632 | 634 | 635 | 635.17 | 635.67 | 636.17 | 636.67 |
| Sharp Ed. Weir "g" | = 3.33 | 17.2 | 26.6 | 28.3 | 33.6 | 39.2 | 45.2 cfs/ft. |
| $Q_w = g \times 56 \times 0.9$ | = 170 | 870 | 1340 | 1430 | 1690 | 1980 | 2280 cfs |

B - Crest Flow Use $q = 2.55 H_c^{1.5}$ [Ref.: V.T. Chow "Open Chan Hydn." pg 52]

① 140' @ el. 634.4 ±; ② 160' @ el. 634.7 ±; ③ 150' @ el. 635.0; ④ 100' @ el. 635.5

| | | | | | |
|--------------|--------|--------|-------|-----|--------|
| Pond El. | 635.67 | 636.17 | 634.7 | 635 | 635.17 |
| Q_1 | 510 | 840 | 60 | 170 | 240 |
| Q_2 | 390 | 730 | — | 70 | 130 |
| Q_3 | 210 | 480 | — | — | 30 |
| Q_4 | 20 | 140 | — | — | — |
| ΣQ_c | 1130 | 2190 | 60 | 240 | 400 |

C - Low Level Outlet

2' Square Conduit, ± 25' long; Gate on Face of Conduit

Total Hd = Ent. (0.5) + Exit (1.0) + Frict. (0.5) = $2.0 \frac{V^2}{2g}$ (Approx.)

Hd = 631 - 617.3 = 13.7'; $V = 21$ fps ±; $Q_c = \pm 84$ c.f.s.

Time to Lower Res One Foot = $\frac{207(43560)}{84(3600)} = \pm 30$ hours

III Crest Flow during Test Flood

Max Depth = 635.7 - 634.4 = 1.3'; $q = 3.78$ cfs/ft.

As Critical Flow: $y_c = 0.76'$, $V_c = 5.0$ fp.s.

⑤ Failure of Dam

Peak Failure Flow:

Pond Elevation - 634.4 (L.P. Crest)

Toe Elevation - 616.3 (at outlet)

$$Y_0 = 18.1$$

Dam Length Subject to Breaching = 260'

$$W_0 = 40\%(260) = 104$$

$$Q_R = 1.68 W_0 (Y_0)^{1.5} = 1.68(104)(18)^{1.5} = \underline{13400 \text{ cfs}}$$

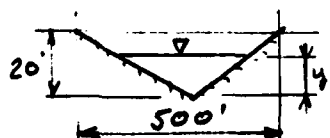
Storage Volume Released:

Storage Above Spillway $3.4(207) = 700 \text{ ac. ft.}$

Storage Below Spillway $\frac{1}{3}(207)14.7 = \underline{1010}$

$S = \text{Total Storage} = \underline{1710}$

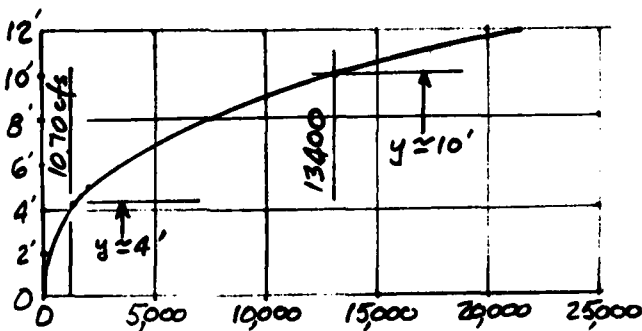
Channel Hydraulics:



$$n = 0.07, S = \frac{20}{700} = .0286; R \approx \frac{1}{2}y; V = 2.27 y^{2/3}$$

$$A = 12.5 y^2$$

| y | A | V | Q |
|----|------|------|-------|
| 5 | 312 | 6.62 | 2070 |
| 10 | 1250 | 10.5 | 13150 |
| 8 | 800 | 9.1 | 7250 |
| 12 | 1800 | 11.9 | 21400 |



Only minor channel storage before failure wave reaches floodplain of Buffumville Reservoir.

Time to Drain:

$$\frac{43560 (1710)}{3600 (\frac{1}{2}) (13400)} = 3.1 \text{ Hours, or } 185 \text{ min.}$$

APPENDIX E

INFORMATION AS CONTAINED IN THE
NATIONAL INVENTORY OF DAMS

GRANITE RESERVOIR DAM

INVENTORY OF DAMS IN THE UNITED STATES

| STATE | FEDERAL ENTITY | DIVISION | COUNTY | DIST. | CONGR. DIST. | NAME | REPORT DATE | |
|-------|----------------|----------|--------|-------|--------------|-----------------------|-------------|-----------|
| | | | | | | | DAY | MO YR |
| 105 | | | | | | GRANITE RESERVOIR DAM | 27 02 | 01 FEB 79 |

| POPULAR NAME | | NAME OF IMPROVEMENT | |
|----------------------|--|--------------------------------------|--|
| GRANITE RESERVOIR | | GRANITE RESERVOIR | |
| RIVER OR STREAM | | NEAREST DOWNSTREAM CITY-TOWN-VILLAGE | |
| OXFORD | | OXFORD | |
| DIST. FROM DAM (MI.) | | POPULATION | |
| 4 | | 10800 | |

| TYPE OF DAM | YEAR COMPLETED | PURPOSES | HYDRAULIC CAPACITIES | | IMPENDING CAPACITIES |
|-------------|----------------|----------|----------------------|----------------------|----------------------|
| | | | STORAGE (ACR. FT.) | PEAK FLOW (ACR. FT.) | |
| CONCRETE | 1950 | 18 | 18 | 1710 | 1010 |

| REMARKS | |
|---------|--|
| | |

| D/S HAS LENGTH | SPILLWAY TYPE | MAXIMUM DISCHARGE (CFS) | VOLUME OF DAM (CU YD) | POWER CAPACITY | | NAVIGATION LOCKS | |
|----------------|---------------|-------------------------|-----------------------|----------------|----------|------------------|--------------|
| | | | | INSTALLED | PROPOSED | NO. OF LOCKS | LENGTH (FT.) |
| 2 | 11 | 1073 | 5000 | | | | |

| OWNER | ENGINEERING BY | CONSTRUCTION BY |
|---------|----------------|-----------------|
| US ARMY | US ARMY | US ARMY |

| REGULATORY AGENCY | |
|-------------------|--------------|
| DESIGN | CONSTRUCTION |
| | |

| INSPECTION BY | | INSPECTION DATE | | AUTHORITY FOR INSPECTION | |
|---------------|--|-----------------|---------|--------------------------|--|
| | | DAY | MO YR | | |
| | | 27 02 79 | | PUBLIC LAW 92-581 | |

| REMARKS | |
|---------|--|
| | |

SCS A
PRV/FED
N N N
21 FEB 79

END

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10-84

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